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A long term Dynamic Model for Planning the Manpow
ducational System of Bangladesh

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by

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1. Introduction:- Some observations on the scope and objectives of the present study.

Although, in recent years a substantial amount of research has been directed toward planning for manpower and educational development in many countries, this has so far been relatively neglected in Bangladesh. Several planning models [100, 102, 109, 125, 130] were developed to analyse the process of economic growth of pre-March 1971 Pakistan and derive policy conclusions for future development. The authors, in general were too pre-occupied with the foreign exchange and the savings constraint to economic development. This approach ignored the fact that even if these resources were available in unlimited quantity, the rate of growth of the economy could still be limited by the shortage of skilled manpower as well as inputs specific to the production of such manpower.[1] In this paper, the intention is to emphasize the interdependence of various aspects of economic development and to relate it to the general question of evaluating the relative profitability of investment in 'human capital' vis-a-vis investment in physical capital in Bangladesh.

1/ This, however, implies the existence of particular functional (fixed coefficient) relationship by which the output and strategic inputs are related in the economy. Although the reliability of such an assertion can be verified only by a thorough empirical study both at the macro and the micro level for the specific country, the frequency with which these bottlenecks were observed, led economists and administrators alike to plan for their synchronized supply.

Several alternative techniques 2/ have been developed for planning educational development. The approach that appears more suitable for Bangladesh is a modified version of the one developed by Adelman [1]. It has several desirable theoretical properties. These properties pertain to some analytical issues in economic, manpower and educational development. These basic issues, which raise some interesting questions are discussed in [5].

In the tradition of optimizing planning models for economic development, a dynamic linear programming model has been formulated to analyse the problems and issues associated with manpower and educational planning in Bangladesh. A number of optimizing models for planning the educational system so that it is in line with the economic system, are available in the literature. Bowles [4] developed a model for Northern Nigerian educational system in which he considered the economic system as exogenous. On the other hand, Adelman [1] presented a model for educational planning for Argentina in which the growth of the economic system is determined endogenously within the model along with the educational system. The approach here closely approximates that of Adelman in the sense that in the model, the economic and educational sectors of Bangladesh are integrated. So it is possible to study the impact of various economic policies on the development of the educational system as well and vice versa.

2/ The more important ones are the manpower requirement approach, the rate of return approach and the programming model approach. These different techniques are discussed in detail in [4].

The model will be related to the development of the Bangladesh economy over a planning horizon of twenty years extending from the year 1965 to 1985. A relatively long planning horizon is warranted to account for the time consuming nature of education. It is well known that investment in education takes a long time before its fruits are reflected in enhanced output via supply of more and better labour skill. However, in order to keep the dimension of the model within a reasonable limit, the planning horizon is divided into four periods, each five years long. The important questions with respect to the economic and educational development of Bangladesh which will be considered in this paper are the following :

1. How should the resources of the society be allocated over time and how is this decision related to social time preference (rate of discount)? What amount of total resources should be invested in education every year? How should resources be allocated among different subsectors of the economy and the education?

2. What is the comparative advantage for Bangladesh in terms of production, exports, and import of various commodities and services? How is the comparative advantage likely to change over time?

3. In the light of the above questions, how should the different types of skilled manpower be distributed among the various economic sectors? How will the structure of the labour force vary over the planning horizon?

4. What is the optimal educational content of the labour force? What are its implications for the pattern of enrollment for various levels of education?

5. Among the graduates of every level what will be the relative distribution between those who continue into further study and those who join the labour force? For dropouts, what proportion will repeat the course and what proportion will join the labour force?

6. What will be the impact on the levels of educational activities if teachers are drawn from among eligible graduates of levels other than teacher training processes?

7. How will the process of educational development be affected if the failure and dropout rates are reduced through increased expenditure?

In section II a brief description of the educational system of Bangladesh will be given. This will help the understanding of the formulation of the model used for empirical implementation. Section III will discuss the model in complete details incorporating all possible alternatives. However, a summary description of the basic reference model which is used for comparison with results of subsequent experiments, will also be added. A discussion of the nature and the source of data underlying the empirical implementation of the model will be contained in section IV. Section V will discuss few

important aspects of the results of the basic reference model. Results of some experiments are presented in section VI.Major findings of the study are presented in the conclusion in section VII.

II. The Education System of Bangladesh - A Short Survey

The present structure of the educational system of Bangladesh follows closely the pattern established during the British colonial rule. Several attempts have been made to modify the system to make it more responsive to the changing needs of the society. However, no fundamental reconstruction has yet taken place. The educational pyramid of the country has five major stages: (a) primary education, (b) junior secondary education, (c) secondary education, (d) higher secondary education, (e) higher education. Finally, teacher education which coincides with both higher secondary and higher education should be treated separately for reasons discussed later.

1. Primary education.

Primary education includes grades I-V and the students generally belong to the age group 5-9. The usual curriculum at this stage consists of reading, writing, arithmetic, elementary science, social studies, physical education, and religious education. Like many other developing regions, the level of primary enrolment as a proportion of the number of school age population is very poor.

According to one estimate made by R. A. Karwanski,[3] only about 46.9 per cent of the total 5-9 year age group population attended school in 1965. The quantitative growth of Bangladesh's education is presented in Table 1.

It follows that over time schools had to accommodate more students than what could be considered as a desirable number. During the First Plan, of the erstwhile Government of Pakistan, it was proposed that the building and equipment of 6,000 out of the existing 26,000 primary schools would be improved but very little was done by the end of the plan.[4] Under the Second Plan 7,552 primary schools were improved. Additional enrolment was about 900,000 which fell short of the plan target of 1.3 million.[5]

3/ R. A. Karwanski, Selected Tables on Projection of Education and Labour Force for Pakistan and Provinces, 1960 to 1990 (mimeo.), ILO/UNDP Manpower Planning Project (Islamabad, 1969), p. 10. The situation is considerably worse in case of female students compared with male as reflected in the enrolment percentage of 66 and 28 per cent within the respective age group.

4/ Government of Pakistan, Planning Commission, The Second Five Year Plan, (Manager of Publications, Karachi), p. 341.

5/ Final Evaluation of the Second Five Year Plan, op. cit., p. 215.

Although the number of teachers in primary schools increased, rom it could not keep pace with the growth in enrolment. So, the student teacher ratio increased from 36 to 43 over the same period. The lack of adequate building and equipment coupled with a high student teacher ratio has contributed significantly to the high rate of dropout among the primary school students. During the early fifties, more than seventy five per cent of students enroled in grade 1 dropped out before they completed even three years at school. The situation improved in the sixties as the corresponding figure dropped to less than sixty. However, for the primary level as a whole, the picture is still quite alarming. Out of every 100 students enroled in grade 1 in 1960-61 only 25.11 remained in grade 5 (final year of primary grade) in 1964-65.6/

The above description raises a few interesting questions about the development of the educational system of Bangladesh. Primary education being the basis of all further levels, it follows that in order to improve the educational composition of the future labour force as well as the population as a whole, considerable emphasis

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6/ Rate of dropout is much higher among female students than male students and in rural areas than in urban areas. A detailed study of the dropout situation is given in: Government of East Pakistan, Planning Department, Manpower Planning in East Pakistan, (East Pakistan Government Press, Dacca), pp. 94-101.

has to be placed on it in terms of providing more physical facilities and increasing the supply of teachers substantially even at the prese student-teacher ratio. It is obvious that for increasing the supply of graduates, measures must be taken to reduce dropout rates. The dropout rates can be reduced by changing either the student teacher or the building student ratio or a combination of both.

2. Junior Secondary and Secondary Education.

For the purpose of present discussion, these two stages will be treated as one. The general age group of students at the secondary stage is 10 - 14 and it includes grades VI - X. Unlike the primary stage, some scope of diversification is available at this stage as students can be admitted into general secondary or technical and vocational schools. However, the main emphasis remains on general education as the facilities for technical and vocational education are very inadequate. It is suggested that the secondary education is the most important stage for developing the background which will help students to acquire various skills in the future. So the curriculum at this level should be as diversified as possible. The Commission on National Education recognised the need to reorganise teaching in secondary schools in a manner that will put greater emphasis on technical and science education. One of its specific recommendation was that the curriculum at the technical and vocational institutes should include 50 per cent craft instruction and 50 per cent general education.7/

7/ Report of the Commission on National Education, op. cit., p. 164.

Over the period 1948-49 and 1964-65, enrolment at the secondary level increased by 54 per cent, the corresponding figures for primary and university education being 60 and 293 respectively. The ratio of enrolment at the secondary level to that of the primary level has remained stable around 21 (with some decline in 1953-54 and 1959-60). This reflects that the economy and the educational system have failed to provide enough incentives for students to continue their education. Secondary enrolment as a percentage of age group was only 9 per cent in 1959-60 and increased slightly to 10 per cent in 1964-65.[8/] The percentage of female students increased steadily from 8.6 in 1948-49 to 10.2 in 1954-55, 12.3 in 1959-60 and 15.2 in 1964-65.[9/]

During the First Plan, secondary education was relatively ignored as its share in the total expenditure on education was only 6 per cent. The Second Plan, however, reversed this trend and allocated 17 per cent to secondary education. About 500 junior high and 900 high schools were improved. The number of new schools established was 781. All these provided for an additional enrolment of 318.5 thousand. However, it may be pointed out that for obtaining a greater number of students into a higher level of education, the number of students into

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8/ To calculate the percentages relevant age group (10-14) population figures were taken from, L.L. Bean, M. R. Khan and A. R. Rukunuddin, Population Projections for Pakistan, 1960-2000, Pakistan Institute of Development Economics, Monograph in the Economics of Development, No. 17, (Karachi, 1968), p. 79.

9/ Calculated on the basis of figures given in 20 years of Pakistan in Statistics, op. cit., p. 172-173.

the secondary level from the primary level must be increased further. This implies that the educational pyramid needs to be modified so as to attain a more balanced shape. In the present model, junior secondary and secondary education (including technical and vocational education) are integrated into one level and called secondary education.

3. Higher Secondary Education.

The average age of entry into the level is 15 years. Before 1960, higher secondary education (it was known as intermediate education) was a subsidiary to the university education in the sense that it was considered to be the preparatory ground for university education. The selection of curriculum and the conduct of the final examination was carried out by the existing universities. The Commission on National Education (1960) recommended the transfer of the control of higher secondary education to the Board of Secondary Education. The basic idea was to form the secondary stage into a complete stage although the institutions providing higher secondary education were made to operate independently of both the high schools as well as the degree colleges as far as practicable.

The diversification in the courses of study at the higher secondary stage is much more clearly defined and institutionalized than at the secondary stage. The stage is divided into general and technical education. In order to facilitate the development of technical education, a separate Directorate of Technical Education

was established in 1963 under the recommendation of the Commission on National Education. The general education covers grades XI and XII. The students at this level are divided into two groups. Those who take liberal arts, commerce and social science courses, and those who take pure science courses. Both are offered in intermediate colleges, although every college may not have the facilities for teaching all courses.[10/] Technical education is provided in polytechnic and mono-technic institutes. The duration of courses is usually three years at the end of which successful candidates are given diploma in various technologies, viz., automobile, civil, mechanical, power radio, leather, textile, jute, ceramics, etc.

As it can be seen in Table 1, enrolment in technical education is only a small fraction of the total enrolment in higher secondary education. However, the rate of growth of technical education has been much more rapid than general education. Between 1959-60 and 1964-65, enrolment in general education increased by about 126 per cent while the corresponding figure for technical education was 359. The First Plan basically tried to reorganise and integrate various institutions of higher education into a comprehensive system. The Second Plan proposed and achieved the development of 53 intermediate colleges. In technical education, 11 new institutes (polytechnic and monotechnic) were established and 9 existing ones were improved. The

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10/ The percentage enrolment in arts, science and commerce in East Pakistan during 1960 was 50, 29 and 21 respectively. See Adam Curle, Planning for Education in Pakistan, (Cambridge: Harvard University Press, 1966), p. 86.

annual intake into diploma courses increased from 337 in 1959-60 to 1,900 in 1964-65.[11/]

The higher secondary level is extremely important in view of the fact that it makes possible the development of comprehensive skills and thus augment the supply of skilled labour. Further along with secondary education, it provides adequate teaching which is helpful for those who intend to continue into university and degree colleges. Because of its importance and also because technical education becomes more prominent at this stage, it is treated as an independent level in this paper. In order to allow for a different period of study in technical education, an average period of study is derived on the basis of weights determined by the base year relative enrolment in the two branches.

4. Higher Education

This constitutes the top of the educational pyramid in Bangladesh. Studies in various courses at this level lead towards Bachelors, Masters and Ph.D. degrees in Arts, Science, Commerce, Engineering, Medical, Agriculture, etc. The usual age of entry is 17 and the minimum educational qualification for entry is higher secondary except for admission into agricultural university and college of arts and crafts where students are taken directly after

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11/ These figures on the Second Plan are obtained from Final Evaluation of the Second Five Year Plan, op. cit., pp. 215-216.

competing secondary education. The duration of the course varies between two and five years depending on the nature of the subject and also the degree for which the student is working.12/

Following the recommendation of the Commission on National Education, the degree sections in most of the combined colleges were separated from the intermediate (Higher secondary) section in terms of administration, accounts, teachers, etc., although the classes are often held within the same building. In this paper, this aspect of reality is ignored as it is assumed that there is no possibility for substitution between school building and equipment for higher education and that for higher secondary education.

University (general) enrolment has grown stadily, although between 1954-55 and 1964-65 the number of universities remained stable at 2. Most of the additional enrolment was possible due to the expansion of facilities at the existing universities. Technical education at the higher level received an impetus with the establishment of the University of Engineering and Technology and the Bangladesh Agricultural University in 1961.

12/ Bachelor's course is two years for 'Pass' level and three years for 'Honours' level. Accordingly, Master's course will be two years for those completing the former and one year for those completing the latter. Bachelor's degree can be obtained in four years from engineering college, (university) five years from medical and agricultural college (university).

In this paper, all different types of university education will be considered as a single unit although it might perhaps be more desirable to make distinction on the basis of engineering and agriculture, medical and others. This has been avoided in order to simplify the model. The duration of this stage is estimated as the weighted average of the duration of all individual courses, the weights being the relative levels of enrolment in the base years as it was in the case of higher secondary education.

5. Teacher Education

To repeat an old saying, no educational system is better than its teachers. In Bangladesh, the problem of quantity and quality of teachers is very acute particularly at the primary and secondary level. These two types will be specifically stressed here. As it was noted earlier, the growth in the number of teachers has been inadequate to maintain a reasonable level of teacher-student ratio. The Second Plan target of additional enrolment at both primary and secondary education could not be achieved because of the shortage of supply of required number of trained teachers. In addition, the quality of existing teachers is far from optimum. It was pointed out in the Report of the Commission on Student Problems and Welfare that in Bangladesh there were about 6,600 untrained non matriculate (those who did not complete secondary education) at the primary stage. This creates a serious problem

of uniformity in the quality of teaching at various schools. Usually the government owned and controlled schools have better trained teachers than the private schools because the minimum qualification requirement is more rigidly enforced, coupled with a better rate of pay and remuneration. The situation is no different for teaching at the secondary level. The Commission on National Education states that in Pakistan as a whole there were about 25,000 secondary school teachers without proper qualification .

At present, there are three principal types of institutions which provide training for teachers into various levels of school education. These are, primary training institutes, junior training colleges and teacher training colleges. Primary training institutes admit students from among secondary level graduates and offer a one year course (Certificate in Education) to be trained as primary school teachers. Commission on National Education suggested that all existing teachers without this training should be given the opportunity to obtain it. This, however, was not implemented because it would have created serious shortage of teachers for a period of time. In this paper, it is assumed that all new teachers into the primary schools should be graduates from primary training institutes. Exceptions, however, are made in the case of higher secondary graduates, university graduates and university dropouts.

Enrolment into the primary training institutes increased from 3,319 in 1954-55 to 8,473 in 1964-65 while the total number of institutes declined from 58 to 48. The decline in the number of training institutes is primarily due to the amalgamation of various units. During the Second Five Year Plan, 27 primary training institutes were improved and 20 new ones were established.13/

Junior training colleges offer a two year certificate course (Higher Certificate in Education). The graduates are used for teachi lower secondary classes (grades VI to VIII). On the other hand, the teacher training colleges present several alternatives. Trainees wit a higher secondary education background go through a one year course to obtain a Certificate of Teaching and they also teach in the lower secondary stage. Those who join teachers' training colleges with a Bachelors degree can get a Bachelors in Education degree with one yea study and be teachers in secondary schools (grades IX and X). Masters in education can also be obtained in some institutions after a three years course instead of one as in the previous case. The National Commission on Education recommended that all teachers at lower secondary level should have a minimum of higher secondary education with two years training. In order to integrate the training course for teachers of secondary education, it is suggested that in the present model all new entrants into secondary teaching be graduates from the higher secondary level. They will go through a two year or four year

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13/ Final Evaluation of the Second Five Year Plan, op. cit., p. 215.

course as the case may be. For the purpose of the model, the average duration of the course is calculated in the same way as in the case of higher secondary and university education. In all of these cases, it is assumed that the proper mix of trainees in different types of courses will be maintained by the admission policy of the authorities concerned.

The number of institutions providing training to secondary school teachers increased from 3 in 1954-55 to 10 in 1964-65, out of which 5 are junior training colleges and the other 5 are teacher training colleges. During the same period, the number of students increased from 207 to 1,173. It is obvious that in order to increase the enrolment at the secondary education level the facilities for teacher training have to be expanded. Under the Second Five Year Plan, 3 training colleges for lower secondary level teachers were improved and 2 new colleges were established. The corresponding figures for secondary level teachers were 4 and 1. The Third Five Year Plan made provision for the development of teacher training facilities on the basis of projected enrolment at the primary and secondary level. It would be interesting to compare the outcome of the present exercise with the target of the Third Plan.

University graduates are the main source of supply of teachers for all other levels. They can enter into teaching without any specific training requirement. Unlike the primary and secondary level, other levels can draw teachers from only one stage within the educational system although they may be permitted to obtain teachers

through import or from among workers in the economic system who have the required qualification.

III. The Model

The analytic framework used to answer the questions raised i introduction will be presented in the following pages. It will be shown how the model incorporates some of the desirable properties mentioned in [5] with respect to various production functions. The model will represent the structural and behavioural relationsh among different variables pertaining to the economy and the educa- tion and manpower sector of a region. The general characteristics of the model are the following.

(a) The model is formulated as a constrained optimization problem. It is assumed that both the objective function, which represents an index of social welfare, and the set of constraints are linear in terms of the structural variables.

(b) The constraints on the different components of the syste are treated separately and their interrelationships are brought ou explicitly.

(c) The model is dynamic. It extends over a finite horizon and the time is considered discretely.

TABLE 1.

NUMBER OF INSTITUTIONS AND ENROLMENT AT VARIOUS LEVELS OF EDUCATION IN BANGLADESH 1948/49 - 1964-65

	1948-49	1954-55	1959-60	1964-65	Percentage Increase Between 1948-49/ 1964-65
Primary Education[a]					
Schools	28977	26000	26583	27649	
Enrolment (in 000)	2531.3	2604.4	3180.4	4044.2	159.8
No. of Teachers	70403	71477	78462	94530	
Student/Teacher Ratio	36	36	41	43	
Secondary Education[b]					
Schools	3551	3079	3053	3834	
Enrolment (in 000)	548.6	457.3	530.5	848.5	154.7
No. of Teachers	24597	22289	23571	33670	
Student/Teacher Ratio	22	21	23	25	
Secondary Enrolment as % of Primary Enrolment	21.7	17.6	16.7	21.0	
Higher Secondary Education					
1) General Schools	N.A.	N.A.	N.A.	139[d]	
Enrolment	N.A.	N.A.	35019[c]	79294[d]	
2) Technical (Polytechnic, Agriculture, Commercial and Engineering/ Survey)					
Schools	N.A.	9	8	24	
Enrolment	N.A.	731	1005	4608	

CONTD-----

TABLE - 1 (Contd----)

	1948-49	1954-55	1959-60	1964-65	Percentage Increase Between 1948-49/ 1964-65
4. Higher Education					
1) Degree College					
Number	N.A.	N.A.	N.A.	82	
Enrolment	N.A.	N.A.	13000[h]	32951	
2) University[e] (general)					
Number	1	2	2	2	
Enrolment	1985	2858	3766	7802	393.0
3) Engineering[e]					
Enrolment	--	596	815	1287[f]	
4) Agriculture[e]					
Enrolment	--	207	446	1001	
5) Medical[e]					
Enrolment	--	875	1055	1780	
6) Others[e]					
Enrolment		430	1269	3853	
5. Teacher Education[g]					
1) Secondary (For Primary Schools)					
Number	N.A.	58	42	48	
Enrolment	N.A.	3319	2926	8546	
2) Higher (For Secondary Schools)					
Number	N.A.	3	5	10	
Enrolment	N.A.	207	379	1173	

CONTD******

TABLE -1 (Contd---)

Notes and Sources:

a) Government of Pakistan, Central Statistical Office, 20 Years of Pakistan in Statistics (Karachi, 1968), pp. 170-71.

b) Ibid., pp. 172-173.

c) Government of East Pakistan, Director of Public Instruction, Annual Statistical Report on Public Instruction, East Pakistan for 1959-60, (Dacca: East Pakistan Government Press, 1963), pp. 89, 93.

d) Number of institutions include 57 intermediate colleges and 82 degree colleges. Enrolment figure consists of 15469 students enroled in intermediate colleges and 63825 students enroled in the intermediate section of degree colleges.

e) Statistical Year Book 1967, Op. Cit., pp. 450, 457-58. Others include Law, Commerce, Home Economics, Social Science and Fine Arts.

f) Government of East Pakistan, Finance Department, Economic Survey of East Pakistan 1966-67, p. 29.

g) 20 Years of Pakistan in Statistics, Op. Cit., pp. 180-81.

h) Government of Pakistan, Planning Commission, Outline of the Fourth Five Year Plan. (1970-75), (Islamabad: 1970), p. 346.

N.A. - Separate data not available.

(d) The economic and the educational systems are subdivided into various subsectors. Labour is classified according to variou skills which take account of the job content of different types of activities.

(e) For the economic and the educational sectors, production technology is assumed to be of the Leontief type. In the case of skill production, the underlying technical relationship follows from the discussion in [5]. It is assumed that there is an unlimited possibility of substutution among various types of educational graduates within each skill.

(f) The following choice elements are available within the model. (i) Non-repeating students may either join the labour forc or they may continue education. (ii) commodities can either the produced at home or they can be imported from abroad. (iii) For th production of various types of skills, it is possible to choose fr among the graduates and dropouts of different educational levels. (iv) To produce skills, choice also exists between drawing persons directly from the educational system or from subsidiary job traini activities. (v) Teacher stock can be augmented from the output of teacher training activities, import from abroad or allowing people with the required educational background from the economic system to join the teaching force.

Classification of Economic Sectors and Labour Skills

As noted above, the economy of Bangladesh is classified into eight different sectors. The sectoral classification here is primarily based on a more detailed classification done by MacEwan [10]. The main criterion chosen for the aggregation was to minimize the extent of heterogeneity of labour skill requirements within each sectoral aggregate. However, for obvious reasons it was also necessary to follow closely the classification under which the available source presented the industrial distribution of the existing labour force.

The comparison between the sectoral classification of this study and MacEwan's study is presented in Table 2.

Data on the labour supply allow some degree of disaggregation by skill category. For the purpose of empirical implementation, the labour force is classified into five distinct skill groups. Major consideration in this scheme of classification has been the underlying functional content of the job performed. However, it was not possible to be very precise in terms of the general educational background of the members of each class. In the context of the model used here, heterogeneity in educational qualification does not present any particular problem since it allows for an unlimited substitution among various types of educational graduates within each occupation. It may be necessary, though, to analyse the composition of each skill group by educational qualification suggested in the outcome of the optimisation exercise carried out here , for deriving useful policy conclusions.

An additional consideration which was taken into account in determining the composition of the various skill groups was to be a much consistent as possible with the occupational classification su gested by I.L.O. The aggregated skill groups and their components are presented below.

1. Farmers, fishermen, hunters and loggers. It includes pri- marily those who are involved in agricultural and related activitie

2. Manual workers. This group includes those people who are directly engaged in production.

3. Clerical, Sales and related workers. The members of this group are involved in white collar jobs without normally being concerned with decision making.

4. Administrative and managerial workers. People in this category are primarily concerned with the decision making and organizational activities. It also includes entrepreneurial func- tions involving risk taking and uncertainty bearing.

5. Professional, technical and related workers. This group includes workers who usually perform the job of specialists in respective fields. The level of sophistication of each specialist within a particular field can however vary depending on the indivi- dual's educational background and pre-job training.

TABLE 2.

SECTOR CLASSIFICATION

Present study	MacEwan Study
1. Agriculture	1. Rice 2. Wheat 3. Jute 4. Cotton 5. Tea 6. All other Agriculture
2. Manufacturing A	7 Sugar 8. Edible Oils 9. Tobacco 10. Other Food 11. Cotton Textiles 12. Jute Textiles 13. Other Textiles 14. Paper 15. Leather 28. Miseellaneous Manufacture
3. Manufacturing B	16. Rubber 17. Fertilizer 18. Other Chemicals 19. Cement 20. Basic Metals 21. Metal Products 22. Machinery 23. Transport Equipment 24. Wood, Cork and Furniture 29. Coal and Petroleum Products
4. Construction	25. Construction of Residential Houses 26. Construction of Non-Residential Buildings 27. All other Constructions
5. Electricity and Gas	30. Electricity and Gas
6. Transport	31. Transport
7. Trade	32. Trade
8. Services	33. Ownership of Dwellings (Housing) 34. Government 35. Services n.e.s.

Algebric Formulation of the model

1. Social Welfare Function

In this exercise the planners are assumed to maximize a soci welfare function which is defined as the sum of the discounted valu of the private consumption (incremental) over the planning period. The welfare function can be written as

$$M = \sum_{t=1}^{4} W(t)\ C(t)$$

where $W(t) = \dfrac{1}{(1 + \mu_s)^{t-1}}$

M = Maximand

W(t) = Weight associated with consumption in period t;

C(t) = Increment in total private consumption in period t;

μ_s = Social rate of discount per period.

These composite consumption C bundle is distributed among various commodities by a fixed proportion.

$$C_i(t) = c_i' C(t)$$

$$\sum c_i' = 1$$

$$i = 1,2,3,5,6,8$$

where

$C_i(t)$ = Increment in the consumption of commodity i during the period t;

c_i' = Proportion of incremental consumption going to i-th commodity.

2. The Educational system Constraints

The basic constraints within the educational system are of two types, the flow constraints and the stock constraints. The flow constraints refer to the distribution of the graduates and dropouts from various educational levels into different activities within the educational system or outside, in the economic system. On the other hand, stock constraints are essentially capacity constraints which relate the enrolment to the availability of teachers, building space and necessary equipment (books, furniture and laboratory instruments). Finally, there are some constraints which arise out of the socio-political and structural considerations and they can be called special constraints.

2a. Flow Constraints

Graduates from each level of education can either be intermediate input (continuing students) or final output (teachers and workers). Dropouts, on the other hand, cannot by definition be intermediate inputs but they can be used as primary input. So, the distributional relationship for graduates can be written as

$$(1-g_p)\rho_p N_p \ (t-1) - \sum_{q=1}^{6} c_{pq} N_{pq} \ (t) - \sum_{s=1}^{5} e_{ps} W_{ps} \ (t)$$
$$- \sum_{r=1}^{6} f_{pr} T_{pr} = 0$$

and for dropouts as

$$g_p \ \rho_p N \ (t-1) - \sum_{s=1}^{5} g_{ps} Z_{ps} \ (t) - \sum_{r=1}^{6} k_{pr} V_{pr} \ (t) = 0$$

where

N_p = Enrolment in schools of type p;

N_{pq} = Graduates from schools of type p entering schools of type q;

W_{ps} = Workers of skill class s originating from schools of type p;

T_{pr} = Graduates from schools of type p becoming teachers in schools of type r;

Z_{ps} = Dropouts from schools of type p who enter labour skill s;

V_{pr} = Dropouts from schools of type p who become teacher in schools of type r;

g_p = Dropout rates from schools of type p;

ρ_q = Labour force participation rate (including continuation probability of students) for persons from school type p it takes account of leakages due to mortality, housewife etc;

c_{pq}, e_{ps}, f_{pr}, g_{ps}, k_{pr} = 1 or 0, indicating whether or not entranc into the category (of students, teachers and workers) is permitted to persons with the given educational background.

Further, there is a population flow constraint expressed as following,

$$N_1 (t) + W^o (t) = \overline{P} (t)$$

where:

N_1 (t) = Enrolment in the primary level in period t;

W^o (t) = Potential new addition to the stock of uneducated workers;

$\overline{P}$ (t) = School age population in period t.

2b. Stock Constraints

There are three different types of stock constraints corresponding to teachers, building and equipment. They put upper bound to the total enrolment at different levels. It is assumed that there is no direct substitution between teachers of various levels although within each level substitution possibility exists among various sources of supply of teachers.

Therefore, the teacher constraint is expressed as

$$u_r t_r N_r(t) \leq (1 - \lambda_r)^t \; T_r^o + \sum_{\tau=1}^{t} \sum_{p=1}^{6} (1 - \lambda_r)^{t-\tau} \; f_{pr} T_{pr}(\tau)$$

$$+ \sum_{r=1}^{t} \sum_{p=1}^{6} (1 - \lambda_r)^{t-\tau} K_{pr} V_{pr}(\tau)$$

$$+ \sum_{\tau=1}^{t} (1 - \lambda_r^f)^{t-\tau} \; T_r^f \; (\tau)$$

$$+ \sum_{\tau=1}^{t} \sum_{s=1}^{5} (1 - \lambda)^{t-\tau} d_{sr} T_{sr} (\tau)$$

where

T_r^o = Stock of teachers of type r at the start of the plan;

T_r^f, = Teachers imported from foreign countries;

$T_{sr}(\tau)$ = Workers from skill s originating in period τ becoming teachers at level r;

t_r = Teacher student ratio;

u_r = The conversion factor expressing the time required by educational process r as a fraction of the planning period. Such adjustment is necessary to express the fact that if the length of the particular course is mor or less than a planning period, less or more than a single student may be educated during the period. This factor also takes account of the repeater rates at each level;

λ_r = Rate of attrition (due to death and retirement) of teachers;

d_{sr} = 1 or 0, indicating whether or not a worker of skill category s can be a teacher at level r.

To allow teachers to leave the profession and join the labour force the following term is introduced with a negative sign to the right hand side of the teacher stock constraint.

$$\sum_{s=1}^{5} d'_{rs} \; T_{rs}(t)$$

where

d'_{rs} = 1 or 0, indicating whether or not a teacher of level r can join skill category s in the labour force;

$T_{rs}(t)$ = Teachers of level r originating in period t joining skill category s.

In this model only three types of physical capital stocks for the school system are distinguished. The first type is related to the primary schools, the second to the higher secondary schools and the teacher training institutes and third to the university and the secondary teachers' training colleges. A uniform one period time log between investment and capacity utilization is assumed.

The equipment and building constraints are

$$\sum_{p} u_p n'_p (t)\ N_p(t) \leq (1 - \delta_j)\ t-1\ \ k^{o}_{j,3}$$

$$+ \sum_{\tau=0}^{t-1} (1 - \delta_j)\ \ I_{j,3}(\tau)$$

and

$$\sum_{p} u_p n_p(t)\ N_p(t) \leq (1 - \delta_j)\ t-1\ \ k^{o}_{j,4}$$

$$+ \sum_{\tau=0}^{t-1} (1 - \delta_j)\ \ I_{j,4}\ (\tau)$$

where,

n'_p = Equipment-student ratio expressed as **Takas** worth of equipment needed for enroling one student;

n_p = Building-student ratio expressed as **Takas** worth of building capacity needed for enroling one student;

j = 9, 10, 11. Index for type of capacity;

j = 9 represents capacity for primary and secondary schools;

j = 10 represents capacity for higher secondary schools and primary training institutes;

j = 11 represents capacity for university and secondary teacher training colleges.

The summation on the left hand side extends over different educational levels within each group.

$k^{o}_{j,3}$ = Equipment stock of type j available at the start of the plan;

$k^{o}_{j,4}$ = Building capacity of type j available at the start of the plan;

δ^{1}_{j} = Rate of depreciation of the equipment of type j;

δ_{j} = Rate of depreciation of the building of type j.

2c. Special Constraints for the Educational System

From the secondary level only a limited number go into the agricultural university. So, the following upper bound on the numbe of students from the secondary to the university level is included.

$$N_{26}(t) \leq \bar{N}_{26}(t)$$

The university enrolment accounting relationship is now given by

$$N_{26}(t) + N_{36}(t) = N_{6}(t)$$

where

$\bar{N}_{26}(t)$ = Exogenously given upper bound on the enrolment into university from among secondary level graduates.

In order to have monotonicity in the level of enrolment (which is also perhaps a socio-political necessity) it is required that during the last two periods, enrolment in each period should at least be as much as in the previous period. Primary enrolment in each period has been constrained not to fall below the level of the initial period.

For $t = 3, 4$ it is required that

$$N_p(t) \leq N_p(t-1)$$

$$p = 2, 3, 4, 5, 6$$

and

$$N_p(t) \leq N_p(0)$$

for all t and $p = 1$.

It is necessary to recognize that the number of teachers leaving the profession to join labour force cannot exceed the total available in each period. However, it is assumed that such leakage does not take place from new entrants or from imported teachers. In other words,

$$T_{rs}(t) \leq (1-\lambda_r)\ T_r^o + \sum_{t=1}^{\tau-1} \sum_{p=1}^{6} (1-\lambda_r)^{t-\tau} f_{pr} T_{pr}(t)$$

$$+ \sum_{t=1}^{\tau-1} \sum_{p=1}^{6} (1-\lambda_r)^{t-\tau} k_{pr} V_{pr}(t).$$

The following accounting relationships are needed to explain the educational background of teacher dropouts.

$$T_{rs}(t) = T_{rs}^{r}(\tau) + V_{rs}^{p}(\tau)$$

where

$$T_{rs}^{p}(t) \leq (1-\lambda_r)\ T_{pr}^o + \sum_{t=1}^{\tau-1} \sum_{p=1}^{6} (1-\lambda_r)^{t-\tau} f_{pr} T_{pr}(t)$$

$$V_{rs}^{p}(t) \leq (1-\lambda_r)\ V_{pr}^o + \sum_{t=1}^{\tau-1} \sum_{p=1}^{6} (1-\lambda_r)^{t-\tau} k_{pr} V_{pr}(t)$$

$$T_r^o = T_{pr}^o + V_{pr}^o$$

where

T^{p}_{rs} = p level graduates among teachers of type r joining the labour class s;

V^{p}_{rs} = p level dropouts among teachers of type r joining the labour class s;

T^{o}_{pr} = p level graduates among initial teacher stock of type r;

V^{o}_{pr} = p level dropouts among initial teacher stock of type r.

3 The Economic System Constraints

3a. Resource Balance

All variables in the economic system are measured in terms of increment over the previous period. The primary constraint here is the commodity balance inequalities which require that the increment in the demand for output of any sector cannot exceed the total supply. So the balance constraint for the j^{th} sector in period t is

$$Y_j(t) + M^{f}_{j}(t) + M^{W}_{j}(t) \leq \sum_{i=1}^{8} a_{ij} Y_i(t)$$

$$+ \sum_{i=1}^{11} b_{ij} I_i(t) + C_j(t) + C^{g}_{j}(t) + X^{f}_{j}(t) + X^{W}_{j}(t)$$

$$+ \hat{I}_j(t) - \sum_{i=1}^{11} b_{ij} I_i(t-1) - \hat{I}_j(t-1)$$

where

Y_j = Increment to production of i^{th} good or services;

M_j^f = Increment to imports from abroad;

M_j^w = Increment to imports from Pakistan;

I_i = Gross fixed investment in i^{th} sector, measured in terms of takas worth of output, i=9, 10, 11 represents investment in different types of school;

C_j = Increment to private consumption;

C_j^g = Increment to government consumption;

X_j^f = Increment to foreign exports;

X_j^w = Increment to exports to Pakistan;

$\hat{I}_j$ = Investment in working capital of type j;

a_{ij} = Incremental input output coefficient;

b_{ij} = Incremental capital output ratio.

Government consumption is exogenously determined and there will be a corresponding equality constraint,

$$C_j^g(t) = \bar{C}_j^g(t)$$

$$j = 8$$

where,

c^g_j = Consumption by the government of the product of sector j.

The rate of growth of the total private consumption, however, is assumed to be at least equal to the rate of growth of population. This monotonicity requirement is introduced in order to retain a nondeclining level of per capita consumption. This can be written as

$$C(t) = (1 + \rho_o)^{t-1} \hat{C}(0)$$

$$t = 1, 2, 3, 4$$

$$C(0) = \bar{C}(0)$$

where,

$\bar{C}(0)$ = Exogenously given level of consumption during the base period;

ρ_o = Rate of growth of population per period.

For exports, it is assumed that scope for further expansion exists and that it can take place at constant prices. However, to express some of the limiting conditions to export expansion (e.g., lack of international advertising and salesmanship) an upper bound is placed on individual exportable items.

Finally, increases in the demand for working capital is explained by the increases in the output of the producing sectors and increases in the final demand (consumption, investment and exports).

$$\hat{I}_j(t) = \sum_{i=1}^{8} w_{ij} Y_i(t) + w'_j \Big[C_j(t) + X^f_j(t) + X^w_j(t) + \sum_{i=1}^{11} b_{ij} I_i(t) \Big]$$

where,

W_{ij} = Marginal working capital coefficient per unit of output increment;

w'_j = Marginal working capital coefficient per unit of final demand.

Imports (from Pakistan and abroad) are divided into competitive and noncompetitive types. Thus, one can write for imports

$$M_j(t) = \hat{M}_j(t) + \bar{M}_j(t)$$
$$j = 1, 2, 3$$

where,

$M_j(t)$ = Increase in competitive imports of type j;

$\bar{M}_j(t)$ = Increase in noncompetitive imports of type j.

Competitive imports are endogenous to the model and are determined simultaneously along with other decision variables. Requirement of noncompetitive imports are determined by increase in output and increase in consumption. The equations describing the demand for noncompetitive imports are derived from the followi relationship,

$$\bar{M}_j(t) = \sum_{i=1}^{8} m_{ij} Y_i(t) + q_{jc} C_j(t)$$

where,

m_{ij} = Incremental import-output coefficient;

q_{jc} = Coefficient representing amount of import needed per unit increase in consumption of type j.

Import activities generate demand for the output of the trade and transport sectors. This arises due to the existence of the port to user cost which has to be taken account of, because the variables of the economic system in this model are expressed in purchaser's price. So the following term is introduced to the right hand side of the balance constraint for transport and trade,

$$\sum_j t_{ij} M_j(t)$$

$$i = 6, 7$$

where,

t_{ij} = Trade/Transport requirement per unit of import of type j.

3b. Capacity Constraints

The capacity constraints which put an upper limit to the increase in output of each sector in different time periods are expressed as

$$Y_j(t) \leq I_j(t-1) - \sum_{\tau=1}^{t-2} \delta_j(1-\delta_j)^{\tau-2} I_j(t-\tau) - \delta_j(1-\delta_j)^{t-1} K_j(0)$$

where,

$K_j(0)$ = Total available capacity at the start of the plan;

δ_j = Rate of depreciation in sector j measured in terms of takas worth loss of output.

3c. Balance of payment Constraint

The balance of payment constraint requires that the total value of import of goods and services cannot exceed the sum of the value of exports and the amount of net capital inflow. This is written as

$$\sum_j M_j^f(t) + \sum_j M_j^w(t) + \sum_r \bar{p}_r T_r(t) + P_{Nx} N_{37} \leq \sum_{j=1}^{3} X_j^f(t) + \sum_{j=1}^{3} X_j^w(t) + F(t)$$

where,

$F(t)$ = Amount of net capital inflow in period t;

p_r = Unit cost of import of teachers from abroad;

P_{Nx} = Unit cost of export of students abroad.

It should be noted that competitive import activity exists for $j = 1, 2, 3$ only and noncompetitive import activity for $j = 1, 2, 3, 6$ and 8. $F(t)$ is exogenously bounded from above. Thu

$$F(t) \leq \overline{F}(t)$$

where,

$\overline{F}(t)$ = Predetermined limit to the net capital inflow in period t.

It should be noted that $F(t)$ is always measured in incremental ter

In order to be realistic the import activities in education should be bounded from above.

3d. Savings-Investment (Incremental) Constraint

This is treated as a behavioral constraint. An explicit savings function is incorporated into the model. It is assumed that the total domestic saving in any period is a function of the total gross regional product of the same period. The marginal propensity to save is estimated exogenously. No attempt is made to obtain alternative estimate of savings parameter for different income groups.

$$\sum_{j=1}^{11} k_j I_j(t) + \hat{I}_j(t) + c_j^g(t) - \sum_{j=1}^{11} k_j I_j(t-1)$$

$$- \hat{I}_j(t-1) \leq s \left[\sum_{j=1}^{8} v_j Y_j(t) \right] + F(t)$$

$$v_j = 1 - \sum_{i} a_{ij}$$

where,

k_j = Marginal capital output ratio for sector j;

s = Marginal propensity to save;

v_j = Coefficient of value added to sector j.

3e. Investment Growth Constraint

In order to ensure a continuously growing level of investment, a minimum growth constraint of $\bar{g}$ per cent per year has been imposed on the level of total investment in each time period. So it is required that

$$I(t) \leq (1 + \bar{g}) \; I(t-1)$$

where

I(t) = Total investment (fixed and working) in period t;

$\bar{g}$ = Rate of growth of investment per period.

4. Skill Constraint

The constraints concerning the skill production and demand are related to both the educational system and the economic system. As pointed out before, the skill production activity requires input from the educational system (primarily graduates and dropouts). However, in the case of farmers and manual workers inputs can be drawn directly from the uneducated population. On the other hand, the demand for various types of skill is generated from the activities in the economic system. In each time period the supply of a particular skill class is composed of the initial stock, new graduates and dropouts joining the labour force during the planning period, uneducated workers and dropouts from the teacher stock. Two types of leakages are to be taken account of. The first arises due to death and retirement and the second due to transfer of workers to the educational system as teacher. It was suggested in [5] that the choice among various sources for the formulation of a particular skill is determined by the relative productivities of workers with different educational background. The relative productivity coefficients are used to convert the units of graduate and dropouts into efficiency units. The demand for labour is a function of the level of output of the different sectors and the labour output coefficients, also expressed in efficiency units. So, this supply and demand relationship provides the most important link between the economic system and the educational system. The skill constraint can be written as,

$$\sum_{j=1}^{8} \ell_{s,j}\, Y_j(t) \leq L_s(t)$$

$$L_s(t) = (1-\alpha)^t\, L_s(0) + \sum_{\tau=1}^{t} (1-\alpha)^{t-\tau}$$

$$\Big[\sum_{p=1}^{7} e_{ps}\, w_{ps}\, W_{ps}(\tau)\, \pi_{ps}$$

$$+ \sum_{p=1}^{7} g_{ps}\, z_{ps}\, Z_{ps}\, \phi_{ps} + \beta_s^o\, W_s^o(\tau)$$

$$+ \sum_{p=1}^{7} e_{ps}\, T_{rs}^{p}(\tau)\, \pi_{ps} + \sum_{p=1}^{7} g_{ps}\, V_{rs}^{p}(\tau)\, \phi_{ps} \Big]$$

$$- \sum_{p=1}^{7} \sum_{r=1}^{6} W_{sr}^{p}(t)\, \pi_{ps} - \sum_{p=1}^{6} \sum_{r=1}^{6} Z_{sr}^{p}(t)\, \phi_{ps}$$

where,

$L_s(t)$ = Total supply of labour skill s in period t;

$L_s(0)$ = Base period supply of labour skill s;

α = Rate of mortality including retirement;

ℓ_{sj} = Labour output coefficients;

W_s^o = Number of uneducated labourers in skill s;

w_{ps}, z_{ps} = Fraction of time for which graduates and dropouts are available for work force. Normally less than 1 in the initial period and 1 in all future period;

π_{ps} = Relative productivity of a graduate of school type p as a worker in the skill group s. It expresses the productivity of a worker with educational background p as a fraction of the sum of productivity of all admissible types of worker;

ϕ_{ps} = Relative productivity of a dropout from school type p as a worker in the skill group s;

ρ_s^o = Relative productivity of the uneducated labour in skill s.

The uneducated workers into skill s in period t are drawn from the potential stock of the period t - 1. This is because th potential stock is residual among the school age population and f into the age group 5-9. But here it is assumed that the minimum a of entry into the work force is 10. Accordingly, the following distributional relationship for uneducated workers is included.

$$\sum_{s=1}^{2} W_s^o(t) \leq (1 - r_o) \; W^o \; (t - 1)$$

where,

r_o = Leakage due to mortality, household work (mostly women), etc.

Accounting relationship for workers going into teaching is

$$T_{sr}(t) = \sum_{p=1}^{7} \sum_{r=1}^{6} WP_{sr}(t) + \sum_{p=1}^{6} \sum_{r=1}^{6} Z_{sr}^{p}(t)$$

As in the case of T_{rs}, an upper bound to T_{sr} in any period is given by the total available labour force within that time per However, to be realistic, only a fraction of the total should be taken as an upper bound.

It is important that a proper educational composition is maintained within each skill. In this model quality constraints ar imposed on two skill categories, professional and technical, and administrative and managerial. The quality constraints are expressed as follows

$$\sum W_{\bar{p}s}(t) + \sum Z_{\bar{p}s}(t) \geq h_s \left[\sum_{p=1}^{7} W_{ps}(t) + \sum_{p=1}^{7} Z_{ps}(t) \right]$$

$$s = 4, 5$$

where,

$\bar{p}$ = Index of levels of education on whom the lower quality bound is imposed. Normally this set will be less than p;

h_s = Represents minimum fraction of entry from educational levels in group $\bar{p}$ into skill s.

5. The Terminal Constraint

Terminal constraints are needed to ensure a reasonable rate of growth during the post-terminal period. In this model a very simple form of the terminal condition is imposed on both the physical and human capital. On human capital, the condition has been formulated as a lower bound on the enrolment in the fourth period. This has been explained above under special constraints. With respect to the physical capital in economic sectors, it is required that the terminal year net fixed investment should be sufficient to provide for an increment in sectoral output during the post-terminal period as large as that during the terminal period. For the education system, it is required that the school capacity at all levels in the post-terminal period should be at least equal to that in the terminal period. In other words, net investment in education during the terminal period should be non-negative. Thus the terminal constraints are expressed as, for the economic system

$$I_j(4) \geq Y_j(4) + \sum_{\tau=1}^{4} \delta_j(1-\delta_j)^{\tau-1} \quad I_j(4-\tau)$$

$$+ \delta_j(1-\delta_j)^4 \; K_j(0)$$

and for the educational system

$$I_{j,3}(4) \geq \sum_{=1}^{4} \delta_j(1-\delta_j)^{\tau-1} \; I_{j,3}(4-\tau).$$

and

$$I_{j,4}(4) \geq \sum_{=1}^{4} \delta_j (1-\delta_j)^{\tau-1} \; I_{j,4}(4-\tau).$$

The above model should be treated as the reference model. However, in the empirical exercise a basic solution is obtained o a relatively simpler version of the above. In this two possibili involving mobility of workers, teachers and students are omitted. First, trading activities in either manpower or education are not considered. Secondly, netiher teachers nor workers are allowed t leave their profession and join other ranks elsewhere within the system. These additional activities and several other parametric variations can be easily introduced to analyse the implication of the various alternative policies.

IV. Empirical Implementation of the Model - Statistical Backgro

The empirical implementation of the model outlined in the previous section was indeed a very difficult task in view of its tremendous "apetitie" for data. It was more difficult to obtain

educational system data than the economic system data. As a result some of the parameter estimates concerning the educational system will be of a tentative nature.

Data for the Educational System

1. Base Period Enrolment, Teacher Stock and Educational Facilities

The base period enrolment data by educational level were taken from two main sources, Pakistan Statistical Yearbook (1967) and 20 Years of Pakistan in Statistics (1967). The number of primary and secondary school teachers was taken from the second source mentioned above. Statistical Digest of East Pakistan (1966) gave figures for teachers in the various teachers' training institutions. The number of teachers in various branches of higher sedondary and university education was obtained in two steps. First, an estimate was made of the probable teacher-student ratio at different levels. These estimates were based on figures given in Statistical Fact Book (1968). In various tables, this document provided some estimates of the teacher-student ratio for pre-March 1971 Pakistan (Table 12.10) and also for Pakistan (Table 12.16). For technical education at higher secondary level some data were available in Planning Commission report on the Development of Polytechnic and Technical Institutes in East Pakistan (1962). The average ratio for the level as a whole was obtained by weighting individual ratios by their respective relative enrolment. The second step involved in estimating the number of teachers was to multiply the number of students

by the teacher-student ratio derived above. The base period enro and teacher stock are shown in Appendix Table 1.

No estimate of the capital stock in education could be fou for the base period. In this paper, two types of capital are dist guished for the school system: building and equipment. The estim are mostly derived by imputing appropriate cost per student place the existing number enroled (corrected for capacity enrolment wher necessary). However, numerous assumptions have gone into such an imputation and it is only fair to spell them out clearly. In addi it was also necessary to obtain an estimate of investment during t base period which would be available in the first period to replac the capacity lost through depreciation as well as to provide for additional enrolment. The method of estimation of the base period capital stock and investment at various educational levels are explained briefly in the following pages.

(a) Primary Level. First, an estimate of the building stoc in 1959-60 was derived by multiplying the 1960 enrolment figure by Taka 100 which was taken to be the building cost of a student plac It is assumed that there was full capacity enrolment in 1960. The per student cost figure was taken to be 55 per cent of the cost pe student in new primary schools as given in Manpower Planning in Ea Pakistan (1969 , page 84). To this, the additional expenditure on improvement of primary school buildings during the Second Plan was added to obtain the total value of capacity of the 1959-60 enrolme in 1964-65. 90 per cent of the total development expenditure on

by the teacher-student ratio derived above. The base period enrolment and teacher stock are shown in Appendix Table 1.

No estimate of the capital stock in education could be found for the base period. In this paper, two types of capital are distinguished for the school system: building and equipment. The estimates are mostly derived by imputing appropriate cost per student place to the existing number enroled (corrected for capacity enrolment where necessary). However, numerous assumptions have gone into such an imputation and it is only fair to spell them out clearly. In addition it was also necessary to obtain an estimate of investment during the base period which would be available in the first period to replace the capacity lost through depreciation as well as to provide for additional enrolment. The method of estimation of the base period capital stock and investment at various educational levels are explained briefly in the following pages.

(a) Primary Level. First, an estimate of the building stock in 1959-60 was derived by multiplying the 1960 enrolment figure by Taka 100 which was taken to be the building cost of a student place. It is assumed that there was full capacity enrolment in 1960. The per student cost figure was taken to be 55 per cent of the cost per student in new primary schools as given in Manpower Planning in East Pakistan (1969 , page 84). To this, the additional expenditure on improvement of primary school buildings during the Second Plan was added to obtain the total value of capacity of the 1959-60 enrolment in 1964-65. 90 per cent of the total development expenditure on

primary schools was assigned as expenditure on building improvement. Secondly, the enrolment capacity of new schools established during 1960-65 was estimated at the rate of 200 students per school. This figure was suggested in a Planning Commission document on Introduction of Universal Primary Education (1959). The value of the building stock in these schools was estimated by applying the cost per student place in new schools suggested in Manpower Planning in East Pakistan (hencefourth referred to as only "MPEP") to the capacity enrolment in new schools. The total value of building capacity in primary schools was the sum of the capacity in old schools and in new schools.

For equipment stock, it was assumed that the per student average equipment cost is Taka 14, which is 50 per cent of the cost in new schools. This figure was multiplied by the capacity enrolment in 1964-65 to obtain an estimate of the equipment stock. However, in the case of students in religious education the per student equipment cost was taken to be Taka 10.

In order to obtain the estimate of investment in the base period, the average building-student and equipment-student ratios from Appendix Table 4 were multiplied by the third Five Year Plan target for additional enrolment in the primary education. It should be noted that all estimates of building and equipment stocks are presented in 1964-65 prices.

(b) Secondary level and higher secondary level. The general methodology applied to obtain the estimate of the building and equipment stock and also the investment in these schools in the base period was the same as that used in the case of the primary level. However, in the case of the secondary level, separate estimates were first made for junior high and high schools and then they were added together to obtain the estimate for the level as a whole. Similarly in the case of the higher secondary level capital stock was separately estimated for general and technical education. The reason for this is that different courses within the same level vary significantly in terms of per student construction and equipment cost. All per student costs (of building and equipment) were derived from the estimates given in MPEP. Relevant enrolment figures were taken from Statistical Yearbook (1967) and Annual Report on Public Instruction in East Pakistan (1959-60). Estimates of additional expenditure during the Second Five Year Plan were taken from various documents, e.g., Final Evaluation of the Second Five Year Plan (1966), Economic Survey of East Pakistan (1961-62, 1962-63, 1963-64, 1964-65), Revised List of Schemes Included in the Second Five Year Plan (1961), Summary Descriptions of Projects and Programs Included in the Second Five Year Plan (1961). For similar data, these sources were used in estimating the capital stock of other school levels. Third Five Year Plan targets were obtained from the plan document as well as Mid Plan Review (1968) of the Third Plan.

(c) University Level. Estimates were made separately for all different courses. Compared to other levels, at this level the variation in the per student cost among different coursed is maximum. For example, according to MPEP, the per student construction cost in new degree college is Taka 1,884 while in engineering college it is about Taka 18,000.

The estimation of degree college capital stock was done in a similar way to that mentioned above. In the case of engineering university and college, the capacity enrolment in 1964-65 was multiplied by the per student cost given in MPEP. Rajshahi engineering college started enrolment in 1964-65 and hence the 1968-69 enrolment was taken to be the capacity enrolment. For agriculture university, the 1966-67 entolment was taken to be the actual capacity in 1964-65. This figure was then applied to the per student building and equipment cost estimated to get the value of the capital stock. The same was done in the case of medical colleges.

For social science, the estimated cost of establishment of the Social / Welfare College was given in the Lists of Schemes Included in the Second Five Year Plan. It was assumed that the building cost accounted for 90 per cent of the total expenditure and the other 10 per cent was used for equipment and furniture.

The agricultural college was assumed to have 25 per cent less per student total capital cost than the agricultural university. Of this total capital cost 75 per cent was imputed to building and 25 per

cent to equipment. The maximum enrolment during the Second Plan was 250, which was accepted as the capacity enrolment in 1964-65. For law colleges, the 1964-65 enrolment figure was taken as capacity enrolment. The per student cost was assumed to be the same as that in degree colleges. Estimates for commerce college was also done in the same way as law colleges.

In the case of general university education, 1968-69 enrolment was taken to represent the capacity in 1964-65. The per student building cost was assumed to be the same as in engineering college, while the per student equipment cost was taken to be 50 per cent of the engineering college.

As explained before, the investment in the base period in all different university courses was estimated on the basis of projected increase in enrolment during the Third Five Year Plan and the average building-student and equipment-student ratios derived from the data generated above.

(d) Primary and secondary Teacher Training Schools. Capacity enrolment in a primary training institute was assumed to be 200 and on that basis the total enrolment capacity in 1964-65 was 9,600. The per student building cost and equipment cost was given in MPEP so that the estimated capacity could be derived easily by multiplying the two.

For secondary teachers' training colleges, the capacity enrolment in 1964-65 was 1,200 (actual 1,173). MPEP gave the per student cost separately for junior training colleges and teachers' training colleges. The average of the two was accepted as the representative cost for a student in secondary teachers' training activity. The method of estimation of the base period investment was the same as before.

The initial building stock, equipment stock, base period investment in building and that in equipment are presented in Appendix Table 4.

2. Teacher-Student Ratio and Permissible Teacher and Student Flow

The teacher-student ratios for the primary and secondary levels, and the teachers' training activities were obtained directly by dividing the number of students into the number of teachers given in columns 1 and 2 of Appendix 1. Derivation of the teacher-student ratio for secondary and university education was described above.

The existing structure of the education permits the flow of graduates from one level to another as continuing students as well as to the teaching stock. Appendix Tables 2 and 3 present the permissible student and teacher flow. This is assumed to remain stable for the period under study.

3. Dropout Rates, Leakage Rates and Average Length of Study

Dropout rates for primary and secondary levels were estimated on the basis of Table 4-1-1 of MPEP. This table works out the movement of an initial enrolment of 100 students in grade 1 in different years, as they proceed through higher levels up to grade X, the final year of the secondary level. All the rates in this exercise were estimated by following the dropout pattern among the 100 students enroled in 1964-65. However, the data existed only up to 1966-67, at which point the continuing students were in grade III. The table was completed to obtain the movement of students up to grade X by applying the dropout rate between 1965-66 and 1966-67 to all successive levels. The dropout rate for the primary level was taken to be the percentage of students enroled in grade 1 in 1964-65 who left the school before completing grade VI. Similarly, the dropout rate for the secondary level was the percentage of students successfully completing grade VI, who left the school system before compleing grade X.

For the higher secondary level, the difference between the number of cnadidates at the higher secondary certificate examination in 1966-67 and the enrolment in 1964-65 was taken as a rough magnitude of the average dropout from that level. This figure was slightly adjusted to take account of two factors. First, of the total number who take the examination, a proportion appear as private candidates (those who in general did not attend college, but studied on their own), and also there are repeaters from the previous period. Second, among those who fail the examination some do not come back to take it again.

At the university level, for the general degree course the estimation method was the same as in the case of higher secondary level. For other courses, the withdrawal figures given in MPEP were taken to be the same as the dropout rates. The base period relative enrolment figure was used as weight to obtain an average dropout rate for the university level as a whole. In the case of teachers training activities, the withdrawal figures given in the above-mentioned document were used as the dropout rate.

The leakage from the students at different educational level takes place for two different reasons, (i) mortality and (ii) housewifery. Age specific death rates were taken from Table XVI of the Report of the Population Growth Estimation Experiment (1968) published by the Pakistan Institute of Development Economics. Mortality rate was assigned to each educational level on the basis of the normal age group of students (e.g., 5-9 for primary level, 10-14 for secondary level, etc.). No allowance was made for the fact that some of the students within the level did not belong to the specified age group. However, such occurances are not expected to be large enough in number so as to affect the mortality estimate significantly.

The leakage into housewifery is calculated on the basis of the data presented in a study by Iqbal Alam (1968) [3] on age at marriage in Pakistan. It was assumed that 25 per cent of the girls getting married in the age group 15-16 and 17-20 comes back to continue their study or to join the labour force. All figures in this study refer to the total female population for various age

groups. It is assumed that the same will be valid for the female students with approximately the similar age range. The leackage from the two sources discussed above were added to obtain the total leakage from each educational level.

The average length of study of an educational level is the actual duration of the course adjusted for the repeater rates. The greater the proportion of repeaters at any particular level the longer will be the effective duration of the course. Thus, if 100 students enrol in a 2 year course and 50 repeat the second year, then the effective duration of the course is 2.5 years, as half of the teacher stock, building and other facilities are blocked up for one more year. In the above example, it was assumed that there were no dropouts. For use in the empirical implementation of the model, the average length of a course is expressed as a fraction of one planning period.

The repeater rates for the primary level were taken from a study on Morocco [22] because no data could be found for Bangladesh. For other levels, it was assumed that all those who failed[15] the final grade examination repeated at least once (that is, took the examination the next year). This will be an underestimate for those levels where intra-grade repetition is significant, e.g., secondary

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15/ Failure rates were estimated from Statistical Year book, 1967, op. cit., and Statistical Digest of East Pakistan, 1966, op. cit.

level. However, the possibility of repetition during years other than the final grade in a course is ignored here. It was assumed that in future this would not be very important. At the higher secondary and university levels, the repeater rates were obtained for different types of courses and, as described above, a weighted average was taken to represent the level as a whole. The dropout rates, leakage rates and the average length of study are presented in Appendix Table 5.

4. Rate of Attrition of Teachers

There are three sources through which the depletion of teacher stock takes place: (i) death, (ii) retirement, and (iii) acceptance of non-teaching jobs. In the initial experiment it is assumed that there is no depletion on account of (iii) above. In government schools and colleges the retirement age of teachers is usually 55, while in the private sector it is 60. This implies that if the new entrants into the teaching force correspond to the age group 20-25, then there will be no loss of teachers through retirement from the new stock except under special circumstances (e.g., retirement due to invalidity) which are being ignored here. Of the available stock in 1964-65, no information exists on the age structure, so that it was not possible to derive the retirement pattern systematically. However, applying the proportion of below 25 and above 25 years of age group for all matriculates according to the 1961 census report, it is found that 85 per cent of the initial primary school teacher

stock belong to the former and 15 per cent to the latter age group. So retirement affects only a small proportion of the initial stock of primary school teachers. Thus, assuming that the over 25 age group is uniformly distributed over the entire age bracket, upward adjustment has been made to the ultimate attrition rate (only from mortality) to account for retirement. For other levels, the distribution of teachers between over and under 25 was obtained on the basis of the age distribution of all degree holders. The resulting proportions were made as in the case of the primary school teachers to account for retirement. In the case of new entrants during the planning period, it was assumed that they belong to the age cohort 20-25, so that only death accounts for a positive rate of attrition.

The age specific mortality rates were obtained from the population growth experiment report cited above. It was assumed that every period 100 teachers enter the teacher force. Then, applying the respective mortality rate per period and also adjusting for retirement in the case of initial teacher stock, the proportion of the survivors in subsequent periods was worked out. As explained above, for the initial teacher stock a distinction was made between the primary school teachers and the teachers for other levels, while for new entrants at all levels only one set of survivor rates was derived. These survivor rates for the initial stock of teachers as well as for the new entrants are presented in Appendix Table 6.

5. School Age Population Constraint

The school age population in different time periods provide an upper bound to the primary school enrolment. In this model this bound is taken from the 5-9 year age group. The final year figure for each planning period gives the u per limit to the flow of school age population during the period as a whole. These figures are obtained from Table 6-5 (fertility assumption II) of the Population Projection of Pakistan (1968), and are presented in Appendix Table 7.

6. Building-Student and Equipment-Student Ratio

These ratios are Presented in Appendix Table 4

Data Related to the Labour Force of Bangladesh

1. Occupational and Industrial Distribution of Labour Force, 1964-65

The census of 1961 provided estimates of the agricultural and non-agricultural labour force by sectors which are very similar to the classification scheme adopted here. The industrial distribution of the labour force in 1965 was obtained by dividing the sectoral value added in 1965 by the sectoral value added in 1965. The value added figures for 1965 was taken from the trend values of a projection made by Khan and Bergen (1966). The value added per worker in 1965 was obtained by applying an assumed rate of growth of productivity to the value added per worker in 1961. The assumed rate of growth of the value added per worker in different sectors was taken from the MPEP (Table 2-II-1). The resulting industrial distribution of the 1964-65 labour force is presented in Appendix Table 8.

To obtain the distribution of the labour force by occupation within each industry, it was necessary to know the occupational pattern within each industry in Bangladesh. With the help of the latter the total labour force in each industry could be classified by skill. For pre-March 1971 the occupational pattern was derived from two studies done by K. Rudd (1967) and F.G. Sheib (1967). These were adjusted on the basis of the Indian data given by Pant, Layard and Burgess (1963). However, these figures mainly related to the non-agricultural sectors. From the 1961 census report, the distribution of the agricultural labour force into farmers and manual labour was obtained. This proportion was applied to the total of 965 to get the respective distribution. The occupational pattern and the occupational distribution of the labour force by industry are presented in Appendix Tables 9 and 10 respectively.

For empirical implementation of the model the initial labour force data by skill were converted into efficiency units in two steps. First, the educational distribution within each skill was derived on the basis of the data on the educational composition of the labour force of Pakistan provided by Nicholas Dewitt (1965). For Bangladesh, this was adjusted by figures from a similar study by K. Rudd (1967). Second, the individual components by education in each skill were added up after being weighted by the relative marginal productivity coefficients. The marginal productivity cofficient is the ratio of the wage of a worker with a particular educational background, say P, to the sum of wages of workers drawn one each from all admissible types of

educational backgrounds. The conversion of workers into efficiency units can be seen clearly from the following relationship:

$$\bar{S}_j = S_j \sum_i w_j \pi_{ij}$$

where,

$\bar{S}_j$ = Number of workers in skill j expressed in efficiency units;

S_j = Number of workers in skill j expressed in absolute units;

w_i = Proportion of workers (S) with educational background i;

π_{ij} = Relative productivity of a worker with educational background i in skill j.

The initial stock of labour force by skill in efficiency units are presented in Appendix Table 11.

2. Labour Output Coefficients

From Appendix Table 10, the occupational distribution of the labour force by sector was used to obtain the sectoral labour output coefficient by skill. The output data by sector were taken from the **MacEwan** (1968) study and the following relationship was used to get the relevant labour output coefficient.

$$l_{sj} = \frac{L_j}{\delta Y_j}$$

where,

l_{sj} = Number of units of labour of skill type s required to produce one unit of output of sector j;

L_{sj} = Number of workers of skill type s employed in sector j;

$\bar{Y}_j$ = Output of sector j.

All figures refer to 1964-65. The annual coefficient is divided by 5 to obtain the coefficient per period. It is assumed that this coefficient remains stable over the planning period.

For the empirical implementation the above coefficients were converted into efficiency units by the method described in the previous section. The educational distribution within each skill for different sectors was assumed to be the same and this in turn was taken to be the same as that used in the previous section for the initial labour force. This assumption is likely to introduce some downaward bias to the coefficients of those sectors which employ a higher proportion of highly qualified skills. On the other hand, sectors employing less qualified manpower will have their coefficients slightly inflated. However, considering the fact that, on the basis of the experiences of other countries one can visualize an upward movement in the educational composition of the labour force over time in perhaps all sectors, the second type of bias is not likely to make any distortion in the final result, whereas the first type of bias may. In order to correct for the underestimation, some of the coefficients in efficiency units which came out to be very low were taken as suspect and were raised somewhat arbitrarily.

No separate data were available for manufacturing A and manufacturing B. So, it was assumed that the labour coefficients of these two sectors are the same as those derived for total manufacturing. Labour output coefficients in absolute and efficiency units are presented in Appendix Table 12.

3. Unemployment of Labour in 1964-65 and the Uneducated Labour in the Initial Stock

The total number of workers of different skills with which the system starts include the unemployed and those of the non-school-going population (uneducated) who were not old enough to join the labour force in the base period.

The estimates of the unemployment by skill were derived in two steps. First, the total available labour force in 1964-65 was estimated by applying a growth rate to the total labour force of 1961.

The above figure was taken from Population Projection of Pakistan (Table V, fertility assumption II). The estimated civilian labour force of 1961 was given in the Census of Pakistan 1961 (Vol. 2). The estimated employment in 1964-65 was subtracted from the above estimate of labour force stock to obtain the magnitude of unemployment. Second, the total number of unemployed persons was distributed by skill according to the figures on the occupational distribution of the unemployed persons taken from

Pakistan Labour Gazette (1967). However, these figures on the occupational distribution are based on the data collected by the employment exchanges in various towns of Bangladesh, so that they may not be properly reflecting the pattern of rural unemployment.

In the case of the uneducated workers, entering the job market (including self-employment) during the first planning period, it was assumed that they can work either as farmers or as manual workers. Their number in each category was derived as follows:

$$W_s^0(1) = n\,(1 - r_0)\,(\bar{P}_0 - N_1^0)$$

where,

$W_s^0(1)$ = Number of uneducated workers of skill type s available for employment in period 1;

$\bar{P}_0$ = Base period school age population;

N_1^0 = Base period primary enrolment;

n = Proportion of the total uneducated workers joining skill type s;

r_0 = Leakage due to mortality, household work (mostly women), etc.;

s = 1 and 2; representing farmers and manual workers respectively.

The value of n was based on the distribution of the rural and urban population in Bangladesh according to the 1961 census. This involved two assumptions. First, the total uneducated workers are distributed between rural and urban areas in the same proportion as the total population in 1961. Second, the uneducated workers from rural areas offer their services mostly as farmers and those from the urban areas as manual workers.

The coefficient of leakage, r_0, was estimated to be one minus the sum of the percentage enroled and the percentage in labour force among the 10-14 year age group. The figure arrived at was about .53. Estimates of the unemployed and the uneducated workers by skill are presented in Appendix Table 13.

4. Survivorship and Retirement Rates of the Labour Force

Like the teacher stock, the depletion of the labour force stock takes place through mortality, retirement and acceptance of jobs as teachers in the educational system. In this model, retirement will affect only the initial stock of labour force. This is because the new entrants into the labour force during the planning period are assumed to belong to the age group 10-25. So, no one should actually retire before the end of the plan since the retirement age is taken to be 65. In the initial experiment, no allowance is made for the possibility of workers moving into teaching.

For the initial labour force, the age distribution was assumed to be the same as that of 1961 stock which is given in the Census Bulletin No. 5 -- Economic Characteristics (1961). The survivorship rates for each age group were calculated from the age - specific mortality rates taken from the Report of the Population Growth Estimation Experiment (1968). The overall survivorship rates in different periods were the weighted sum of the rates for different age group. These rates are presented in Appendix Table 14.

The survivorship rates for the new entrants to the labour force (other than the uneducated workers) and the uneducated workers were calculated separately. The difference between these two groups is that, the former belongs to the age-group 10-25 at the time of joining the labour force and the latter belongs to 10-14. The rates for these two groups are presented in Appendix Table 15.

5. Labour Force Assignment by Educational Attainment

This is shown in Appendix Table 15a. It reflects the permissible flow of the educational graduates and dropouts into various types of skill.

6. Relative Productivity Coefficient of Labour with Different Educational Background

This parameter provides the essential link between the growth of the economy and that of the educational system. It assigns the graduates and dropouts into different skills. The basic assumption underlying this approach is that within each occupation the relative contribution of a worker is a function of his educational background (i.e., say, number of years of schooling). In this model, it is further assumed that the relative contribution of workers with different educational background does not depend on the relative supply.

In the absence of any technological measure of the productivity of workers, their relative earnings data were taken as an approximate index of their relative productivity. Following the notation of section III, the relative productivity coefficient of a worker with educational background i in skill category j can be expressed as :

$$\pi_{ij} = \frac{W_{ij}}{\sum_{i=1}^{n} W_{ij}}$$

where,

W = Earnings of a worker with educational background i in skill category j.

Thus the estimation of π_{ij} required data on W_{ij}. Unfortunately no systematic survey of the wage structure by educational backgournd in various occupations had ever been made for Pakistan or any one of its regions. However, there are some scattered published sources containing some relevant data from which an implicit wage structure was developed. The published documents which were used for this purpose include the following: The People of Karachi: Economic Characteristics (1966), National Sample Survey (1959-61, 1964), Report on the Ninth Regular Wage Survey of West Pakistan (Northern Zone) (1963), Report on the Survey of Prices of Building Materials, Transport Charges and Wage-rates of Construction

Labour of Dacca, Chittagong, Khulna and Rajshahi (1966), Report of the Pay and Services Commission (1966), Revision of Pay Scales of Non-Gazetted Government Servants (West Pakistan) (1963), Pakistan Labour Gazettee (1961-62) and a study by S. R. Bose on the Trend of Real Income of the Rural Poor in East Pakistan (1968).

Data from these various sources were put together to estimate a set of productivity coefficients in the manner described above. These coefficients, however, were further adjusted on the basis of (a) discussion with various persons in business and government; and (b) two other studies on Chile and Morocco [22, 23] respectively, which contained data on the relative productivity of workers with different educational backgrounds. The resulting set of productivity coefficients are presented in Appendix Table 16.

The Economic System Data

Most of the basic data concerning the economic system were taken from the study by MacEwan (1968). In certain cases, however, the data was updated by the additional information provided in a later study done by Khan (1969). But the major adjustment required in the data was the aggregation of sectors. While MacEwan's study was based on a 35 sector model and Khan's on 29 sectors, the present model considers only eight sectors. It was generally assumed in the basic model that, all of the coefficients remained unchanged over the entire planning horizon.

1. Incremental Input-Output and Capital-Output Coefficients

The input-output (incremental) table constructed by MacEwan was based on 35 sectors. The following adjustments were made to the MacEwan input-output table in order to use it in the present model: (a) MacEwan's assumption of non-linear production function for rice was abandoned in favour of a fixed coefficient production function. The table was thus completed by obtaining the coefficients for the rice sector from Khan. (b) MacEwan's table was further corrected along the lines suggested by Khan to take account of changes in input structure and product composition of some of the sectors (e.g. cement, basic metal and machinery) and also to include possibility of new production (e.g. coal). The complete set of input output coefficients is presented in Appendix Table 17.

The incremental fixed capital output coefficients were also taken from MacEwan with adjustments suggested by Khan (1969). Khan, however, made his adjustments to the original joint Khan and MacEwan study (1967) on average capital coefficients for 1962-63.

For the present model the following procedure was adopted to obtain a set of sectoral capital coefficients on the basis of those provided in the above-mentioned studies. The estimated coefficients in MacEwan's (1968) table was replaced by Khan's estimate whenever the former differed from the latter. However for aggregated sectors in Khan's table, MacEwan's estimates were retained since the basis for aggregation could not be clearly established. Furthermore,

the annual coefficients derived above were divided by 5 to obtain the coefficients per period. The resulting set of capital coefficien are presented in Appendix Table 18.

5 2. Incremental Working Capital-Output and Import-Output Coefficient

The working capital requirement arises due to both increase in production as well as increase in final demand. In this model only three sectors, agriculture, manufacturing A and manufacturing B provide output for satisfying demand for working capital. The working capital coefficients related to increase in output were obtained from MacEwan (1968). His table was completed by including coefficients for rice and coal and petroleum from Khan (1969). The working capital requirement per unit of final demand were also obtained from MacEwan.

Like all other coefficients, import coefficients were obtained as a compromise between the MacEwan and Khan estimates.

The import-output coefficients are all taken from MacEwan with the following adjustments: In cases where the sectoral definition by Khan was identical with MacEwan, Khan's coefficients under moderate import substitution were taken. In the case of large discrepancy between the two, the Khan coefficient for rapid import substitution was taken.

The non-competitive import requirements for consumption were estimated separately. They were directly aggregated from MacEwan's table.

The incremental non-competitive import coefficients are presented in Appendix Table 20 and 21.

3. Marginal Consumption Proportions and Trade/ Transport Coefficient on Imports

It was pointed out in section III that, the incremental total private consumption was distributed among various commodities in fixed proportions. These proportions are referred to as the marginal consumption proportions and they were derived from Khan (1969).

The trade and transport coefficients were taken directly from MacEwan (1968) and aggregated according to the present model on the basis of the weights derived from the sectoral import figures of 1964-65 given also in MacEwan.

The marginal consumption proportions and the trade/ transport coefficients are presented in Appendix Table 22.

4. Estimates of the Base Period Data

The variables and parameters in this model refer to a five yearly planning period. For the base period, it was assumed that some macroeconomic aggregates, viz. gross regional product, consumption (private and government), exports, imports and investment in working capital were five times the estimates given by MacEwan for 1964-65. Since in this model capital stock is measured in capacity terms, the base period capital stock by sector was also taken to be five times the output of the corresponding sector in 1964-65.

The method of estimation of investment in educational facilities was described above. Fixed capital investment estimates for different economic sectors were also made in the similar manner. A set of sectoral growth rates were applied to the output of 1964-65 to obtain the incremental requirement for capacity in 1969-70. The total increment for the first period (i.e., 1965-70) was set at five times the level of 1969-70. The sectoral capital coefficients were then used to convert the capacity increment into the demand for investment goods from the manufacturing B and construction sector in the base period. The sectoral rates of growth used here were primarily based on the rates of growth achieved by various sectors in MacEwan's (1968) basic solution. However, these figures were adjusted on the basis of alternative estimates (implicit or explicit) available in The Third Five Year Plan, Khan & Bergen (1967) and a Planning Commission document, Employment by Regions and Sectors (196[illegible]). The resulting sectoral growth rates (per annum) were as follows:

Agriculture	4.0
Manufacturing A	8.6
Manufacturing B	19.0
Construction	9.7
Electricity & Gas	12.9
Transport	10.0
Trade	9.0
Services	10.0

The estimate of the total replacement demand during the base period was made as residual from the estimated gross regional product. The complete set of relevant base period variables is presented in Appendix Tables 23, 24 and 25.

5. Rate of Discount, Marginal Rate of Saving and the Rate of Depreciation of Capital Stock

The maximand in this model is the discounted present value of the increments to the total private consumption. To be conceptually regorous the rate of discount should be derived directly from an intertemporal utility function and should therefore, reflect the marginal social rate of time preference between the consumption of successive periods. In the absence of any idea about the precise analytic form of such a utility function that might be underlying the judgement of the Planners, a uniform figure of 8 per cent has been arbitrarily selected as the rate by which the value of total consumption in successive time periods will be discounted.

In the model, saving is defined as excess of income over private consumption. Government consumption is assumed to come out of savings of the economy. Thus savings here includes all types of savings, public or private. The assumed marginal rate of saving is 23 per cent for the economy as a whole and it is applied to all planning periods. This limit is very close to the figure assumed by MacEwan and also corresponds closely to the assumption underlying the Perspective Plan of the erstwhile Pakistan Planning Commission.

The rate of depreciation is treated here as the percentage loss in output capacity per period in each sector. These rates were derived in several steps. (a) On the basis of the MacEwan classification scheme, the proportions of different types of capital goods in each sector were estimated. (b) Then the useful life of a unit capacity in each sector was calculated as follows:

$$L_j = \sum_i \epsilon_{ij} l_{ij}$$

$$\sum_i \epsilon_{ij} = 1$$

where,

l_{ij} = Useful life of capital good i in sector j;

ϵ_{ij} = Proportion of capital good i in sector j;

L_j = Useful life of a unit capacity in sector j.

(c) The annual rate of depreciation in terms of the loss of output capacity was given by $1/L_j$. The rate per period would be $5 \times 1/L_j$. (d) Finally, the above rates were aggregated according to the classification scheme of this model.

The capital goods proportion by type were derived from the fixed capital coefficient matrix. Assumptions about the useful life were based on the figures given by MacEwan (1968) and Khan (1969). After making adjustments on the basis of international data the following figures were accepted as the useful life of various types of capital goods.

Type of Capital Good	Useful Life
In Economic Sectors:	
Building (not housing)	40 years
Other Construction	20 years
Machinery	16 years
Transport Equipment	10 years
Metal	12 years
Wood, Cork, etc.	12 years
In Educational Sectors:	
Primary/Secondary--Building	30 years
Primary/Secondary--Equipment	15 years
Higher Secondary Primary teaching -- Building	40 years
Higher Secondary/Primary teaching-- Equipment	15 years
University/Secondary teaching--Building	50 years
University/Secondary teaching--Equipment	20 years

In the economy, it was assumed that the useful life of each type of capital good is the same in all sectors. On the basis of these assumptions, the estimated useful life of a unit capacity in each sector and the corresponding implicit depreciation rates per period are presented in Appendix Table 26.

Exogenous Variables

1. Private and Government Consumption Expenditure

It is assumed here that the private consumption expenditure must grow at least at the same rate as the rate of growth of population. From the PIDE Population Projection of Pakistan, the estimated population growth was taken to be 3.5 per annum or 18.8 per period.

The increase in government consumption per period was estimated exogenously at fixed levels. It was assumed the government consumption will increase at the rate of 25 per cent per period. The estimates are presented in Appendix Table 27.

2. Exports and Foreign Capital Inflow

It was assumed that given the basic structure of the Bangladesh economy as well as the forces in the international market, it will not be possible to expand the foreign export beyond a certain limit. On the other hand, similar bounds were placed on exports to Pakistan.

For foreign exports, a maximum rate of 7 per cent growth a year, or 40.25 per cent per period was imposed on overall exports. This rate was based on MacEwan (1968), Khan 1969) as well as export projections made in the Outline of the Fourth Five Year Plan (1970) for major exportables. These studies further suggested that of the incremental exports, the share of agriculture will be less than that in the base period. As a matter of fact, in the case of jute, which is the single most important foreign exchange earner for Bangladesh, the Fourth Plan outline projected an absolute decline in the total value of exports over the period 1970-75. This, however, appears to be a little over pessimistic picture. It may be expected that, over time the exports of some of the other subsidiary products will increase enough to maintain a resonable rate of growth of agricultural export. Of these, the most important are tea, tobacco, fruits and rice. Normalization of the trade relationship with India is likely to open up a substantial market for the most of these products.

On the basis of the above, it was assumed that over the planning period, agriculture's share in the incremental exports will be 25 per cent. Manufacturing A is expected to maintain the Second Plan pace of growth and account for the largest share of incremental exports in future. The most important item in this category is jute products. The Fourth Plan projects a rate of growth of 12.7 per cent per annum for exports of the products of this industry. Other items of importance include cotton textiles, other textiles, paper and paper products, leather and products. Thus, 70 per cent of the foreign export growth is being attributed to manufacturing A.

Although it may be true that the exports of manufacturing B will be increasing, it is unlikely to do any better than 5 per cent of the incremental exports. This increase is likely to come through the expansion of the sectors like chemicals, fertilizer, metal products, rubber, machinery, coal and petroleum products, etc.

The same sources as mentioned above, as well as C.S.O. (Central Statistical Office) Monthly Bulletin of Statistics, Economic Survey of East Pakistan (1960-61 - 1967-68) were used to derive the limits on the growth of exports to Pakistan. It is assumed that export to Pakistan will grow at the rate of 8 per cent per year, or 46.93 per cent per period. Study of the trend in sectoral growth of exports suggests the following share of the incremental exports for different sectors:

Agriculture	40 per cent
Manufacturing A	50 per cent
Manufacturing B	10 per cent

The proportion of investment in Bangladesh out of foreign capital was always much below the average for pre-March 1971 Pakistan in the past. In fact, during the base period, the estimated foreign capital inflow accounted for only about 19 per cent of the total gross investment. In the course of the future development plans, a more generous flow of foreign funds can be expected into Bangladesh. In the basic model the upper limit to the incremental capital inflow is set at Taka 2000 million per period.

V. Optimal Strategy for Economic, Manpower and Educational Development of Bangladesh

The Economy

1. Gross Domestic Product and Consumption. Macro-economic Accounts in terms of both the increment and the total in different time periods are presented in Tables 3 and 4. Other important macro parameters are given in Table 5.

The rate of growth of the regional product over the entire planning horizon is 5.5 per cent per annum. The model maintains an almost steady rate of growth over the period. There does not seem to be much variation in the rate of growth in different periods. The growth rate of the economy obtained here is somewhat lower then that revealed in MacEwan study. This may be a little surprising in view of the fact that the empirical bases, with respect to the economy, are similar in the two studies and the objective function is maximisation of consumption in both cases. So, the difference in the growth rate can be explained by the difference in the following. (a) Degree of aggregation of sectors. The consideration of only eight sectors in the present model was inadequate to bring out the importance of the structural change within the economy and its favourable impact on the rate of growth. (b) Structure of the model. The MacEwan model does not explicitly incorporate the skill constraints and it is comparative static in nature covering a period of only ten years (1964-5 to 1974-5). While the present model includes five different types of skills, MacEwan assumes unlimited supply of all skills, Hence, it is expected that other things being the same, the short period model will not be able to foresee the bottlenecks that might emerge later in the course of development. So, there

TABLE - 3

Macro-economic Accounts-Increments Over the Previous Period

(Taka Million)

	Period 1	Period 2	Period 3	Period
1. Consumption	27104.2	38233.0	47533.2	67185.
(i) Private	26200.2	37103.0	46120.7	65852.
(ii) Public	904.0	1130.0	1412.5	1765.
2. Investment (Gross)	8921.7	11839.2	11475.8	14643.
(i) Economic Sectors	9305.9	10995.3	12563.7	10637.
(ii)Educational Sectors	-384.2	843.9	-1087.9	4006.
3. Investment (Net)	7271.2	9604.3	8748.3	11064.
4. Replacement	1650.5	2234.9	2727.5	3578.
5. Investment in Working Capital	6954.8	5908.5	3942.4	6136.
6. Exports (f.o.b.)	3810.1	5427.5	7736.0	11031.
7. Imports (c.i.f.)	5810.1	7427.5	9736.0	13031.
(i) Competitive	1914.3	3837.3	5937.0	8851.
(ii)Non-Competitive	3895.8	3590.2	3799.0	4179.
8. Net Capital Inflow	2000.0	2000.0	2000.0	2000.
9. Gross Domestic Product	34025.9	48072.1	57009.0	80261.

10. Annual Compound Rate of Growth Over the Entire Period = 5.5

Notes: (1) All figures represent total increment for a five yearly period.

(2) Gross investment figures include investment in working capital except for educational sectors in which case the working capital figures are included with those for economic sectors.

TABLE - 4

Macro-economic Accounts-Total

(Taka Million)

	Period 0	Period 1	Period 2	Period 3	Period 4
1. Consumption	97237.6	124341.8	162574.8	210208.0	277726.5
(i) Private	93621.6	119821.8	156924.8	203045.5	268898.4
(ii) Public	3616.0	4520.0	5650.0	7062.5	8828.1
2. Investment (Gross)	20818.4	29740.1	41579.3	53055.1	67698.3
(i)Economic Sectors	19902.9	29152.8	40148.1	52711.8	63349.0
(ii)Educational Sectors	915.5	587.3	1431.2	343.3	4349.3
3. Investment (Net)	18712.9	15984.1	35588.4	44336.7	55401.5
4. Replacement	2105.5	3756.0	5990.9	8718.4	12296.8
5. Working Capital	5002.5	11957.3	17865.8	21808.2	27944.5
6. Fixed Investment	15815.9	17782.8	23713.5	31247.0	39753.8
7. Exports (f.o.b.)	9021.0	12831.1	18258.6	25994.6	37026.0
8. Imports (c.i.f.)	12999.5	18809.6	26237.1	35973.1	49004.5
9. Net Capital Inflow	3978.5	5978.5	7978.5	9978.5	11978.5
10. Gross Domestic Product	114077.5	148103.4	196175.5	253184.5	333446.3

Notes: (1) All figures represent the total for a five yearly period.

(2) Gross investment figures include investment in working capital except for educational sectors in which case the working capital figures are included with those for economic sectors.

will be no tendency to economize the use of any factor from raising the output in the immediate future in favour of restructuring the economy for facilitating later development.[16] It should, perhaps, also be mentioned that the MacEwan model treated Bangladesh as one of two regions of a country while in the model used here Bangladesh is treated as an independent unit.

The growth path of consumption reflects the same smooth pattern as income. The annual compound rate of growth of consumption for the entire planning period is 5.4 per cent. What is most important to note here is that the smooth consumption gorwth pattern was obtained even without a consumption growth constraint. It is usually a common experience with the dynamic models, that in the absence of any monotonicity requirement, the growth path exhibits flip-flop tendency (Eckaus and Parikh, 1968). The smooth consumption growth path in this model can be attributed to the incorporation of the skill constraints as well as the educational sectors. The demand for investment in education is tied to the natural sequence of the production process of education implicit in its assumed structure. Both of these factors acted against the inherent tendency of the model to concentrate all of the increments in consumption in the earlier periods.[17]

16/ MacEwan incorporated some agricultural growth limits which have been ignored in this model. In the context of a long-term planning model, this is not too unrealistic. So, like all other sectors the agricultural growth is limited by the structure of demand in all periods except the first. In the first period, the additional constraint on the sectoral growth is given by the extent of the new capacity created in the base period.

17/ It should be added, however, that the investment growth constraint also contributed to the moderation of the flip-flop tendency.

TABLE - 5

SOME MACRO PARAMETERS IN THE BASIC SOLUTION

	Period 1	Period 2	Period 3	Period 4
1. Annual Rate of Growth of Consumption	5.0	5.4	5.2	5.7
2. Annual Rate of Growth of Population	3.5	3.5	3.5	3.5
3. Annual Rate of Growth of GNP	5.3	5.7	5.2	5.7
4. Annual Rate of Growth of Per Capita Consumption	1.5	1.9	1.7	2.2
5. Annual Rate of Growth of Per Capita Income	1.8	2.2	1.7	2.2
6. Marginal Rate of Saving	23.0	23.0	19.1	18.0
7. Incremental Capital Income Ratio				
(i) Gross	3.1	3.1	3.6	3.3
(ii) Net	2.8	2.7	3.1	2.8
8. Total Capital Inflow as a % of Total Gross Investment	20.1	19.2	18.8	17.7
9. Non-Competitive Import Requirement Per Unit of Output Increment	.0789	.0530	.0468	.0372
10 Annual Rate of Growth of Consumption Over the Entire Period	= 5.4			

2. Investment

Total investment grows steadily with the gross regional product. Investment as a percentage of the gross regional product remains stable around 20 per cent in all four periods. It is interesting to note that while investment in the economic sectors rises steadily over time, there is some fluctuation in investment in education.

Total fixed investment in education is attributable to the demand for additional capacity only in the first and the second period. In later periods all investments are essentially replacement investment. However, there is one exception to this. In the final period the total fixed investment in education goes up very much due to high investment in primary education. This additional investment in primary education is necessitated by the investment growth constraint imposed on the total investment. However, this pattern of total investment in education reflects that the economy responds to the shortage of skills developed in the later periods by creating educational facilities in the earlier periods. The concentration in the earlier period is explained by the "dual" lag involved in educational investment. The first lag is the usual investment capacity utilization lag. In the context of education this lag exists between the time when investment takes place in a certain level of education and the time when the first enrolment is possible. The second lag involves the time between the enrolment and the actual addition to the labour force. Since the model involved only four periods, no additional capacity was needed to be created during the last two periods, in response to the demand for additional

skill from the economy which were to be generated in the post terminal and subsequent periods. The terminal conditions required only the maintenance of the existing capacity for use beyond the planning horizon.

Two preliminary conclusions with important implications for policymaking can be derived from the analysis of the aggregate investment pattern. First, decisions regarding investment in education must be taken in the context of a longer planning horizon than that what is needed for investment in economic sectors. Secondly, during a period of transition when the economy is moving from a state of disequilibrium to equilibrium in terms of sectoral pattern of growth, no such simple criterion as that of a fixed proportion of national product suggested by UNESCO[18/] can be used to determine the total volume of investment in education.

The most important aspect of the total investment in relation to income is the underlying aggregate capital income ratio which reflects the capital cost of the plan in different periods. The capital income ratio can be defined in two ways, depending on whether the replacement investment is included or not (i.e., gross or net). There is no significant trend over the whole period in the capital cost (gross or net) per unit of output. However, it seems that there

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18/ UNESCO suggests that a country should devote at least four per cent of the gross national product in every period to education. This was supported by the Education Commission (1969).

is a tendency to economise capital in the first half of the planning period while this was reversed in the latter half. This is quite consistent with the fact, that capital is a binding constraint only during the first two planning periods.[19/]

Investment in general is determined by the requirement for the depreciation and the creation of new capacity. Within education, the allocation of funds into different levels will be a function of the contribution of the graduates and dropouts to the total incremental consumption over the planning horizon. However, the overall allocati in education will also reflect the adjustments necessary in the econo in order to operate within the existing skill and educational constra- ints. On the other hand, investment in the economy and its various subsectors will be completely dominated by the optimal growth strateg discussed above. Sectoral investment figures for the different plann periods are presented in Tables 6 and 7.

The investment pattern in education clearly reflects an emphasi or primary education. Secondary enrolment did not increase at all during the planning periods. Hence, the entire amount of the primary- secondary investment in excess of the replacement investment is accou ted for by the rise in the primary enrolment up to period 3. Between

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19/ It should be noted here that, one need not attach too much importance to the movement of the per unit capital cost as derived above. The reason for this is that, the conventional definition of the aggregate capital cost does not truly reflect the actual cost to the user or to the economy. The relevant comparison should be between the investment and the entire stream of income generated from it over the lifetime of the installed capacity.

period 3 and period 4 no new capacity was created at these levels since the enrolment in the primary level declined in the fourth period. The replacement investment in the building stock was also postponed until the fourth period. However, there was some investment in equipment stock which probably accounted for replacement. The implication here is that it was profitable to divert resources from the primary level education to the economy in period 3 to add to the productive capacity of period 4.

There is a very sharp increase in the investment outlay for the primary level in the terminal period. This is primarily explained by the fact that in order to satisfy the economy wide investment growth constraint in this period, the model had to create excees capacity in the primary-secondary level. As it was explained in Chapter 6, the investment growth constraint was introduced in order to ensure a high rate of growth of income and consumption in later periods. Within the framework of the model, this constraint was satisfied up to period 3 without creating any excess capacity in any sector. In other words, the required growth of the total investment was consistent with the nature of growth of investment demand by the economic and the educational sectors. However, it seems that in period 4, the total investment required by the investment growth constraint exceeded the actual demand, so that it was necessary to undertake excess investment for new capacity in some sector. The model selected the cheapest outlet, which in this instance, turned out to be investment in the building capacity for the primary-secondary level.

TABLE - 6

Investment in Education in the Basic Solution

(Taka Million)

	Period 1	Period 2	Period 3	Period 4
A. Education				
1. Building				
(i) Primary-Secondary	318.4	975.2		3975.4
(ii) Higher Secondary-Primary Teaching		44.3	46.1	45.6
(iii) University-Secondary Teaching		52.8	52.2	52.8
2. Equipment				
(i) Primary-Secondary	69.0	158.1	44.4	74.7
(ii) Higher Secondary-Primary Teaching	5.2	8.0	8.1	8.0
(iii) University-Secondary Teaching	49.0	47.1	46.8	46.8

TABLE 7

Basic Solution Physical Investment in Economic Sectors

(Taka Million)

	Period 1	Period 2	Period 3	Period 4
1. Agriculture	2281.0	2982.2	4410.4	5003.5
2. Manufacturing A	2200.0	3015.2	5034.9	5034.8
3. Manufacturing B	1507.4	1491.0	1127.4	1176.8
4. Construction	253.7	331.5	448.5	527.3
5. Electricity and Gas	953.7	1241.8	1704.3	1936.4
6. Transport	1902.4	2515.1	3550.3	4035.1
7. Trade	1973.4	2603.9	3608.9	3986.1
8. Services	6269.7	8247.2	11747.9	12960.3

Note : Figures in this table are derived by multiplying the investment figures in capacity terms by the respective sectoral capital-output ratio.

In the higher secondary-primary teaching level, there is no investment in building stock and only a little investment in the equipment stock in the first period. The main reason for this is that after the first period there is no further enrolment at the primary teaching level and hence the entire depreciated building and equipment stock is being utilised by the higher secondary level alone.[20/] And further, the enrolment in the higher secondary level during period 2 and subsequent periods being equal, there is only marginal investment at this level in these periods to take account of replacement. Investment in the university and secondary teaching level can also be explained in a similar way in terms of the growth in enrolment over time.

It should be noted here that the sectoral distribution of investment in education is affected not only by the terminal conditions but also by the additional enrolment constraints for different educational levels. So, although the emphasis on primary education is clear, the magnitude of investment in other levels of education should be used cautiously. This undoubtedly is a weaker aspect of the empirical implementation of the model. The structural shortcoming of this model will be further exposed when the pattern of enrolment is analysed. Hence, in drawing conclusions about resource allocation in education, one must seriously take account of these

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20/ This is possible because of the assumption that building and equipment stocks are substitutable in use between higher secondary and primary teaching education.

factors. The importance of capital cost and depreciation is brought out more clearly in the figures for physical investment in various sectors. These are derived by multiplying the investment figures in capacity terms by the respective sectoral capital-output ratio. It is evident from Table 7 that the major emphasis in terms of physical investment is on the social overhead sectors. In all periods, services claim the maximum amount of investible resources followed closely by transport and trade. In point of fact, fixed investment in the social overhead sectors accounts for about two-thirds of the total fixed investment in the economic sectors in all periods. It should be noted that in all sectors there is an acceleration in investment between period 2 and period 3. The reason for this is that, the requirement for the terminal investment influences the investment in period 3, in order to increase the output capacity in period 4. It can also be partly explained by the fact that capital is not a binding constraint in this period.

From the above, two general conclusions can be drawn with respect to the sectoral investment policies. First, given the social welfare function, the underlying structural relationship between the economy and various types of education indicate that a relatively greater emphasis has to be placed on investment in primary education. Secondly, in order to realise even a moderate rate of growth of the economy of a magnitude suggested in the basic model, investment in the social overhead sectors must grow very rapidly over the entire plan period.

The Manpower

1. Structure of the Labour Force

It was pointed out earlier that the growth of the economy as well as the need for replacing the depreciated stock would create demand for additional workers in various skill categories over the planning horizon. However, because of the dynamic inter-period link, the labour force in certain skill categories will often be augmented in anticipation of the demand created in one or two periods later.

The structure of the total labour force by skill, as shown in Table 8, is very stable in the sense that there is little change in the percentage distribution by skill. Farmers constitute about 77 per cent of the total labour force, followed distantly by manual workers who constitute 15 per cent. Thus, all other higher skill categories account for only about 8 per cent of the total labour force in all periods. This stability in the structure of the labour force is a direct consequence of two assumptions: (a) Stability of the labour output coefficient over the entire planning horizon; and (b) the possibility of substitution within each occupation among various types of educational graduates and dropouts. Continued growth of the agricultural sector has also played an important role in the stability of the structure of the labour force over time, because farmers constitute the bulk of the agricultural labour force.

The industrial distribution of the labour force by skill measured in efficiency units is presented in Appendix Table 33. As expected, agriculture absorbs the maximum amount of labour both in terms of total and increment. However, the share of agriculture in the total employment declines slightly from 88.4 per cent in the base period to 83.3 per cent in period 4. Among the non-agricultural sectors, manufacturing A and services are the most important. Their combined share increases from 6 per cent to 10 per cent over the same period. Thus, it is clear that althouth non-agricultural sectors experience a significant rate of growth during the planning horizon, they are not capable of absorbing a significantly larger proportion of the total labour force.

From the above one can draw the conclusion that the only way to shift the labour absorptive capacity among the various activities would be to introduce, as far as practicable, labour intensive technology in non-agricultural sectors. The existing pattern of the resource availability and technology will clearly continue to put pressure on agriculture to provide further employment. However, it should be noted that in the basic model, the unemployment problem does not arise except in the first and the second period. But one should take note of the fact that since labour is measured here in efficiency units, the achievement of full employment by the third period will depend on the successful realisation of the implicit educational distribution of the work force.

TABLE - 8

Number of Workers by Skill in the Basic Solution

(in 000)

	Period 0	Period 1		Period 2		Period 3		Period 4	
		New	Total	New	Total	New	Total	New	Total
1. Farmers	15160	6149	19487	6493	23594	8093	29561	11377	38253
2. Manual	3281	799	3686	1315	4499	1705	5767	2289	7501
3. Clerical and Sales	1246	277	1373	359	1542	817	2199	1166	3154
4. Administrators and Managers	124	7	116	57	155	34	173	61	215
5. Professionals and Technicians	208	94	277	240	483	80	528	107	591
6. Total-for all skills	20019	7326	24939	8464	30273	10729	38228	15000	49714

Note : Period 0 figures include unemployed persons.

A note may be added here on the implicit total labour cost to the economy of the development programme in different planning periods, which is reflected in the movement of the aggregate labour coefficient over time. The aggregate labour coefficients by skill are presented in Table 9.

It is clear that the economy adjusts itself to reduce the total labour cost. The amount of labour per one million takas worth of output declines from 120.2 in period 1 to 106.1 in period 4. As the economy moves from a labour surplus to a labour shortage state, the decline in the aggregate labour coefficient becomes very significant, which is reflected in a sharp fall in the coefficient between periods 1 and 2. By period 3 all of the unemployed labour have been absorbed, and the scope for further structural adjustment in order to reduce the requirement of the number of workers seems to have been almost exhausted. This is shown by a very slight fall in the combined aggregate labour coefficient between periods 3 and 4. Thus, although all of the labour constraints were binding in the last two periods, there was not sufficient time and resources left to be able to reduce the number of workers per unit of output by raising significantly the average educational qualification of the new entrants to the labour force.

From Table 9, it is clear that the trend in the use of different skills per unit of output over time is different. For example, while the aggregate labour output coefficient for farmers and manual workers declines over time, it is almost stable for the administrative class

and fluctuates in the case of the clerical and professional classes. It should be noted that a fall (rise) in the aggregate labour coefficient for a skill can be brought about in two ways: (1) by shifting the structure of production in favour of the sectors which are less (more) intensive in the use of these particular skills, and/or (2) by substituting higher (lower) level educational graduates for lower level ones among the new entrants. It is apparent that a rise in the aggregate labour output coefficient for the clerical and professional workers has been primarily caused by the second method.

2. Educational Attainment of the Labour Force

Skills are formed by drawing graduates and dropouts from the various levels of education. The basic solution gives the input mix in terms of the source of graduates and dropouts into a skill in different planning period. These variables refer to the new entrants into the labour force either as net addition to the existing stock or as replacement of the depreciated stock. It should be noted that, the educational input into a newly-formed skill coming as replacement does not necessarily have to be the same as that of the part of the stock being replaced. The educational pattern of the replacement skill is determined by the optimization procedure of the model. The flow into the different skills from various educational levels in all planning periods are presented in Table 10.

The farmer class obtains the entire amount of additional labour from the primary dropouts and uneducated persons except in period 4 when some primary graduates join as farmers. In the case of manual workers, primary graduates constitute a significant proportion of the newly-formed skill. It should be pointed out that, of the total available uneducated persons, only a small fraction join as manual workers, and they are perhaps mostly employed in agriculture. This is clearly explained by the relative productivity coefficient of the uneducated workers in the farmer and manual categories of labour.

The new entrants into the clerical and sales skill have increasingly diversified educational backgrounds over time. In the first period the new entrants are dominated by the secondary graduates while in later periods primary dropouts, higher secondary graduates and dropouts, and primary teaching dropouts join. This trend towards diversification of the educational input seems to have been caused by the need for economising the educational input per worker in this skill. Since higher educated persons are relatively more productive in higher skill category, the model has assigned a smaller proportions of these to the clerical and sales group. On the other hand, a large flow of primary dropouts were available after a portion of them were assigned to farmers, and these were absorbed to meet the demand for clerical and sales workers where their productivity was highest.

TABLE 9

Total Labour Output Coefficient Per Period by Skill in the Basic Solution
(Number of Workers Per Tk. 1 Million Worth of Output)

	Period 1		Period 2		Period 3		Period 4	
	Marginal	Average	Marginal	Average	Marginal	Average	Marginal	Average
1. Farmers	87.6	93.9	60.7	85.7	73.6	82.9	77.3	81.6
2. Manual	8.2	17.8	12.0	16.3	18.7	16.2	15.4	16.0
3. Clerical and Sales	2.6	6.6	2.5	5.6	8.1	6.2	8.5	6.7
4. Administrators and Managers	.3	.6	.3	.6	.2	.5	.2	.5
5. Professionals and Technicians	1.4	1.3	3.0	1.8	.6	1.5	.6	1.3
6. Total For all Skills	100.1	120.2	78.5	110.0	101.2	107.3	102.0	106.1

Notes : Estimates of coefficients are based on the total available labour force.

TABLE 10

Educational Distribution of the New Labour Force in the Basic Solution

(in 000)

	Period 1	Period 2	Period 3	Period 4
1. Farmers				
(i) Primary Graduate				489.8
(ii) Primary Dropout	3455.1	4371.0	5408.3	9365.1
(iii) Secondary Graduate				
(iv) Secondary Dropout				
(v) Uneducated	2694.0	2121.7	2684.4	1521.7
2. Manual				
(i) Primary Graduate	448.5	1030.5	1417.7	2205.2
(ii) Primary Dropout				
(iii) Secondary Graduate				
(iv) Secondary Dropout	208.6	122.8	84.0	84.0
(v) Uneducated	142.0	161.7	203.3	
3. Clerical and Sales				
(i) Primary Graduate				
(ii) Primary Dropout		198.3	682.5	1031.6
(iii) Secondary Graduate	276.6	138.7		
(iv) Secondary Dropout				
(v) Higher Secondary Graduate			35.5	35.5
(vi) Higher Secondary Dropout		18.4	98.7	98.8
(vii) Primary Teaching Dropout	0.3	3.8		

Contd-----

	Period 1	Period 2	Period 3	Period
4. Administrative and Managerial Workers				
(i) Primary Graduate				
(ii) Primary Dropout				
(iii) Secondary Graduate	6.6			
(iv) Secondary Dropout				
(v) Higher Secondary Graduate		5.7		53.5
(vi) Higher Secondary Dropout		50.9		
(vii) Secondary Teaching Dropout				
(viii) University Graduate	0.7		33.6	7.8
(ix) University Dropout				
5. Professional and Technical				
(i) Primary Graduate				
(ii) Primary Drooout		216.1		
(iii) Secondary Graduate	56.8			
(iv) Secondary Dropout				
(v) Higher Secondary Graduate		23.8		
(vi) Higher Secondary Dropout	27.5			
(vii) University Graduate	9.4		57.8	83.9
(viii) University Dropout		0.2	21.8	23.4

The administrative and professional groups utilise the major proportion of the higher level graduates and dropouts in all periods. However, in the second period a substantial number of primary dropouts join the system as professionals. In general, over time the new entrants into these skills have originated from homogenous educational backgrounds. For example, in the last two periods professionals are formed only by persons with university education.

A precise index of the educational attainment of the labour force is the average and total man years of education of the total and newly-formed skills. The movement of the average educational attainment of the labour force over time reflects the extent to which it is profitable to invest in education in order to increase the productivity of labour.

From Appendix Table 34, it is found that the combined average educational qualification of the total labour force increases from 1.07 years in the base period to 2.67 in period 4. For the new entrants, the average increases from 2.54 in period 1 to 3.46 in period 4, as can be seen in Appendix Table 35. As pointed out earlier, although there was some increase in the educational qualification of the labour force, this was by no means enough to warrant a large investment in education. The model found it cheaper to absorb all of the unemployed persons in the first two periods and draw only moderate numbers of people from higher levels of education to form the new skills. This tendency is clearly the result of a high dropout rate at the primary level, as well as the presence of a large number of uneducated persons.

One can estimate the marginal and average educational input per unit of output. This will reflect the cost of the development programme in terms of human resources. Human resource is defined here as the total man years of education embodied in the labour force. In Appendix Table 36, the human resource cost is expressed in terms of the number of man years of education per Taka 1 million worth of output. It is clear that to the economy, the total human resource cost increases over time as the combined average educational input moves from 180.51 to 282.98. Thus, the productivity of education declines over time. Other things remaining the same, this significantly declining trend in the productivity of education explains the limited amount of investment in education.

The trend in the productivity of education can perhaps be analysed better with the help of Figure 1, which presents the marginal and average product of education in different periods. The marginal and average product of education are measured in terms of output and they are reciprocal of the marginal and average educational input per worker as given in the bottom row of Appendix Table 36. In Figure 1, these values for the marginal and average product of education in different periods are plotted against the total number of years of education of the entire labour force in different periods obtained from Appendix Table 34. Joining the points, two curves are derived representing the movement of the average and marginal product of education over time. Since these two curves (curve A and Curve M in Figure 1) relate the average and marginal product of education to

total years of education of the labour force at different points of time rather than at any one particular point of time in the planning horizon, they may be said to represent the long run average and marginal product curves of education.

It can be concluded from the analysis presented above that, over time the skill requirement of the economy will have to be fulfilled partially by increasing the number of years of education of the new entrants compared with the existing labour force. However, because of the relative scarcity of the complementary factors, the productivity of education falls over time. Thus, it is apparent that to make education more productive, some structural breakthrough in terms of expansion of exports, savings and reduction of dropout rates will be necessary.

The Educational Strategy

Enrolment in the different educational levels emerges as a natural consequence of the optimization process in the model. The level of enrolment will reflect the demand of the economic system for educated manpower, and enrolment in a particular level will take place up to the extent that equalises the marginal product with marginal cost. Enrolment in the different educational levels is presented in Table 11. From this table, one can draw various conclusions about the desirable educational strategy over the planning horizon with the given basic resource structure of the economy.

The model calls for an increase in the primary enrolment in all periods but the last. Contrary to this, the secondary enrolment declines considerably in importance over the entire planning horizon. The peak in primary enrolment is reached in period 3 when about 81 per cent of the school age population is enroled. This represents almost doubling of the percentage enrolment over the base period. The emphasis on primary education is desirable because it is profitable for all lower level skills to increase their proportion of primary graduates and dropouts to meet the increased demand for skills from the productive sectors of the economy.

The profitability of the primary graduates as inputs in various skills is reflected in the fall in secondary enrolment in periods 1 a 2, compared with the base period. However, through the additional enrolment constraints the enrolment in the last three periods has bee maintained at a constant level. This result should be contrasted with the conclusion of the National Commission on Education (1960) which specifically emphasized the role of secondary education. On the other hand, these results correspond closely to the sentiment expressed in the second Education Commission Report (1969) to the extent that emphasis is shifted from secondary to elementary educatio

Higher secondary and university-level increases enrolment between periods 1 and 2, and then the additional enrolment constraint assures the stability of the second period enrolment level. Clearly, in all of these levels the last two periods' enrolment is not complet desirable from the point of view of the objective of this model, but

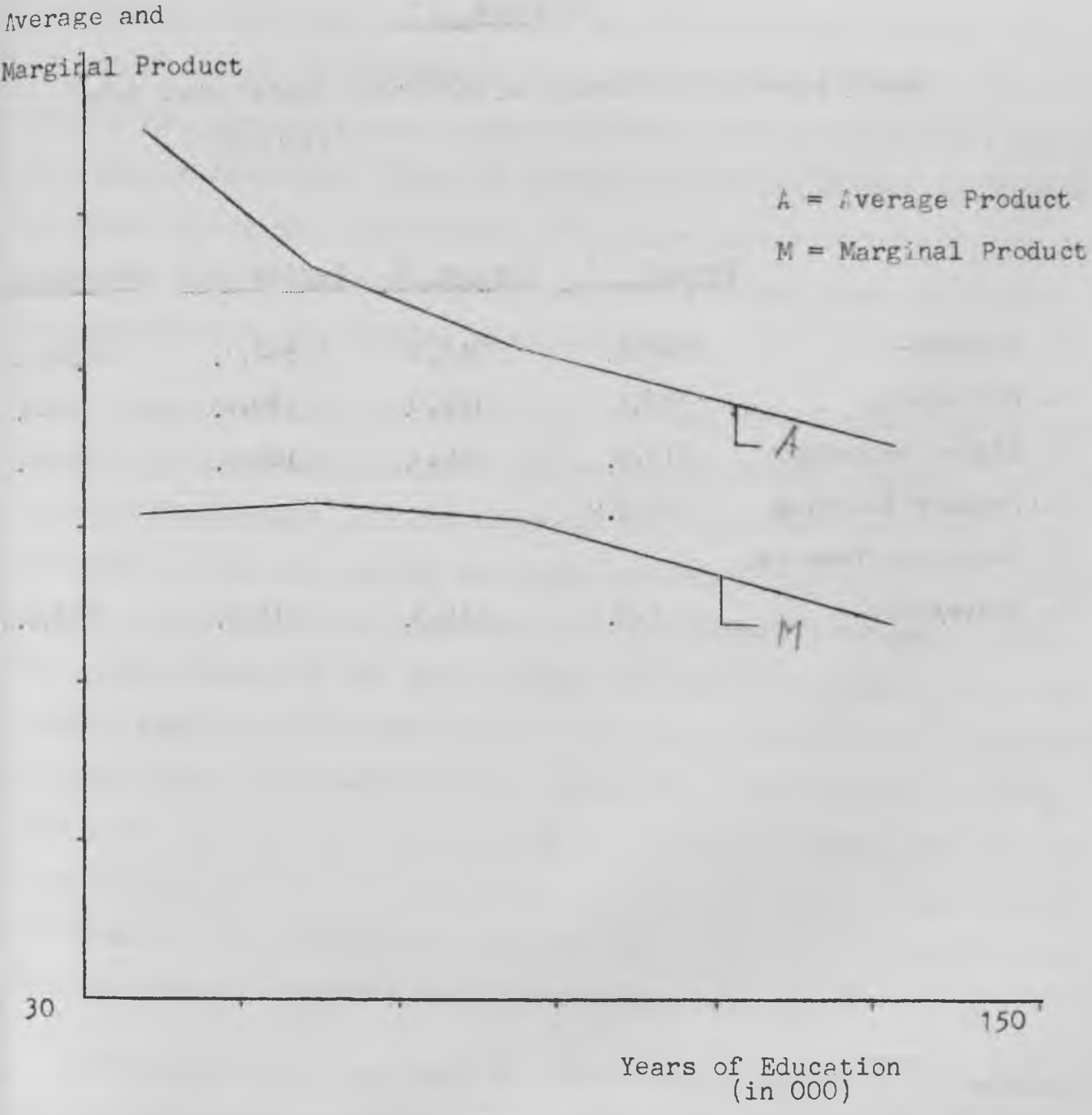

Figure 1.

Marginal and Average Product of Education in Different Periods.

TABLE 11

Basic Solution Enrolment in Different Educational Level

(in 000)

	Period 1	Period 2	Period 3	Period 4
1. Primary	6242.4	7945.2	13562.1	11058.0
2. Secondary	568.4	389.0	389.0	389.0
3. Higher Secondary	213.2	304.1	304.1	304.1
4. Primary Teaching	192.7			
5. Secondary Teaching				
6. University	1.0	115.3	115.3	115.3

compared with the base period there is a considerable greater emphasis on higher education. Except in the first period, a greater proportion of both the secondary and higher secondary level graduates are channelled into higher education. This is because all of the higher skill levels draw more graduates and dropouts from these levels to satisfy the demand for skill from the economic sectors. In addition, they contribute significantly to the teacher stock as well.

Teacher training activities are at zero level except for primary teaching in the first period. The secondary teacher category does not need any significant addition because of the of the sharp decline in enrolment. In fact, during the early periods of the planning horizon, it was not necessary to undertake any replacement investment. From the point of view of the basic model, the very high shadow price for primary teacher stock constraint in the first period, made it profitable to draw primary teachers from the graduates of the primary teaching activity. So, the new enrolment in the primary teaching activity is concentrated in the first period at a level much higher than that of the base period. Additional contribution to the teacher stock comes from the higher secondary and university levels.

The pattern of enrolment explains the allocation of investment among the various educational sectors (levels). On the basis of the profitability criterion underlying the basic model, there is a clear policy implication to favour the development of the primary and higher education as opposed to secondary education. However, the case for

higher education may not be very convicing at least in the third and the fourth period, when the additional enrolment constraints are binding, but a more suitably formulated terminal condition would have indicated continued emphasis on higher education.

B. Some Reflections on the Dual

A few remarks are in order to explain the significance of some of the shadow prices generated by the dual linear programming model. In the context of the present model, the shadow price of a scarce resource represents the amount of increase in the discounted present value of the incremental consumption over the planning period which would be obtained if the resource under consideration is increased by one unit. The shadow prices associated with different groups of constraint in the primal are presented in Appendix Table 3.

It is interesting to note that the first period shadow prices associated with graduates and dropouts, are negative. The reason for this is that, the base period enrolment at different educational levels is exogenously given and all of the student flow constraints being equalities, the model is forced to absorb the available graduates and dropouts. The negative shadow price indicates that the original distribution of the different type of graduates and dropouts, was not optimal.

Higher productivity of higher level graduates and dropouts relative to lower levels, is indicated by their higher shadow prices. What is more important, for the same level of education, the shadow price of a graduate is higher than that of a dropout. Furthermore, the declining marginal and average productivity of total education is reflected in the general declining trend of shadow prices of graduates and dropouts from all educational levels, except secondary graduates and dropouts and primary teaching dropouts.

Some of the teacher stock constraints are binding. They indicate the presence of a structural time lag which creates a bottleneck in the formation of teachers. However, they may also represent the fact that the admissible graduates are more productive elsewhere in the economy.

School building and equipment constraints which are inequalities for the first period, are mostly non-binding. It reflects an inconsistency in the base period investment and the planned projection of enrolment in the different educational levels.

The most important shadow prices which reflect the growth potential of the economy are those associated with the basic resources, capital, skills, and foreign exchange. In particular, the relative shadow prices indicate the relative scarcity of the various resources. The relative factor prices, with the price of foreign exchange as numeriare are presented in Table 12. A number of observations can be made on the basis of this table.

First, using the relative prices to rank different resources in terms of their importance as a bottleneck to the development of Bangladesh in the first period, the order will be skill (administrati -managerial and professional-technical), foreign exchange, and capita In the second and third period, the bottleneck ranking changes significantly and foreign exchange turns out to be the most important of all factors since all the relative prices in these periods are less than unity. In the second period, the capital constraint is as important as the managerial skill but less important than professionals and technicians. In the third period, however, the capital constraint is no longer binding and among skills, the administrative-managerial constraint becomes the most important bottleneck. In the fourth period a second factor scarcity reversal takes place since all the skill constraints become dominating with administrative managerial category again as the most important. Capital, on the other hand, remains non-binding.

Secondly, in general, the relative prices of the higher skill categories are greater than those of the lower skill categories. This implies that the underlying cost of creating a unit of higher skill is greater than that of creating a unit of lower skill. The high shadow price for higher skills also reflects the importance of the constraint imposed on the system by the educational time lag which was discussed above.

TABLE 12

Relative Factor (Primary) Prices in the Basic Solution

	P_K/P_{FE}	P_{LF}/P_{FE}	P_{LM}/P_{FE}	P_{LCS}/P_{FE}	P_{LAM}/P_{FE}	P_{LPT}/P_{FE}
Period 1	0.76	0	0	0	1.31	1.40
Period 2	0.21	*	*	*	0.21	0.42
Period 3	0	0.12	0.27	0.35	0.54	0.42
Period 4	0	1.39	1.86	3.90	5.88	4.67

Notes: (1) P_K = Shadow Price of Capital;

P_{FE} = Shadow Price of Foreign Exchange;

P_{LF} = Shadow Price of Farmer;

P_{LM} = Shadow Price of Manual Worker;

P_{LCS} = Shadow Price of Clerical-Sales Worker;

P_{LAM} = Shadow Price of Administrator and Manager;

P_{LPT} = Shadow Price of Professional and Technicians

(2) * insignificant

Third, from the relative price of capital in all periods, it follows that the role of foreign funds in augmenting foreign exchange resource is more important than its role in augmenting capital from the point of view of the growth of Bangladesh. As it was pointed out before, in fact, the foreign fund came in to substitute part of the domestic effort for mobilizing resources for development.

The scarcity of higher skills in the first and second period is explained by the fact that the quality constraints imposed on them were binding. Similarly, the additional enrolment constraints on the last two periods' enrolment into various educational levels were also binding. As expected the shadow prices associated with all of these constraints are negative, implying that these said political requirements have cost the economy the loss of total consumption over the planning horizon. This is to be expected because had there been no constraint on enrolment, a greater number of persons could have joined various skills, thus raising the output and consumption.

From the above analysis, it follows clearly that in the context of this model, skills and foreign exchange turn out to be the most important bottleneck for economic development of Bangladesh. Several important policy conclusions can be drawn from the relative prices of the different basic resources. (1) In order to remove the foreign exchange bottleneck, vigorous effort must be directed towards export expansion. This primarily refers to the improvement of the international shipping and marketing organization, in order to capture

new buyers. It also points the need for the developed countries to offer preferential treatment to Bangladesh exportables, as far as practicable. (2) Related to the above is the need for reducing the requirement of non-competitive imports. This implies that within the framework of the overall sectoral priority ranking, Bangladesh should develop those industries which will produce substitutes for imported intermediate inputs, and thus reduce the requirement for non-competitive imports. (3) A third way to reduce foreign exchange scarcity is to increase the substitutability between domestic capital and foreign exchange. This will enable the economy to utilize the surplus domestic savings capacity for output expansion. (4)On the whole, it appears that the additional enrolment constraints should be relaxed so that a greater number of graduates from the lower levels of education can join the various skills, thus reducing their scarcity. (5) It seems that the scarcity of all types of skills can be reduced greatly by reducing the dropout rates since this will make available an increased number of graduates to join the labour force. This follows directly from the productivity differential between the graduates and dropouts in all skills.

VI. Some Experiments and Comparison with Basic Solution

The use of a model of the type discussed here, lies in working out a large number of choice alternatives for the possible future course of action. This is done by solving the model under alternative assumptions about the parameter values, exogenous variable values or

the set of constraints. It makes easier the task of the decision making authority in formulating appropriate policies to implement a programme of future action with respect to the economic and educational development of a country.

A. Influence of Enrolment Constraints

Basic reference model (referred to as SO) was changed in two directions. First, the monotonicity requirement in enrolment during last two periods for all levels except primary, and the lower bound on primary enrolment, both were dropped. This solution is referred to as S1. Second, a socio-political constraint was added in terms of requirement for universal primary enrolment by the last period of the Plan. This solution is referred to as S2.

Since the absence of enrolment constraints enable the model to divert investable funds from the educational system to the economy the objective functions attain the highest value in S1 followed by S0 and S2. But the difference is very small, less than 2 per cent. An examination of the macro-economic parameters (Appendix Table 38) indicate a similar pattern. There is very little difference in the income and consumption growth under three alternative enrolment assumptions. This clearly indicates that the cost of additional enrolment constraint is very negligible. In particular, there seems to be a strong reason for advocating the case for universal primary educati

as envisaged here, since it does not lead to any serious reallocation of scarce resources in terms of objective of the model.

The investment pattern in education as shown in Table 13, undergo some changes in the three different solutions. In S2, there is considerably more investment in education as compared with SO and S1, and this is true for all periods. The reason for this is that in S2 the primary level enrolment and the primary teacher training enrolment are greatly emphasized.

In order to realise a greater amount of investment in education in S2, some sacrifice in total consumption was necessary. So, the realised marginal rate of saving in S2 is higher than those in SO and S1 in periods 3 and 4 when the saving constraint was not binding. In period 3 the greater emphasis on investment in education obtained in S2 compared with / other solutions is reflected in a slightly higher incremental capital income ratio.

The structure of the labour force by skill under the different solution strategies, does not undergo any significant change at all. However, in the educational composition of the new labour force some interesting differences can be discerned.

It is apparent that the requirement for universal primary enrolment, by the end of the Plan, has the effect of raising the primary enrolment in both the third and the fourth period and thus the availability of a large number of primary dropouts and graduates

TABLE 13

Investment Pattern in Education Under Alternative Enrolment Constraints

(Tk. Million)

	Period 1	Period 2	Period 3	Period 4
A. Building				
(i) Primary-Secondary				
S0	318.4	975.2		3975.4
S1	260.4	928.0		3926.2
S2	283.8	1213.4	977.5	5550.1
(ii) Higher Secondary-Primary Teaching				
S0		44.3	46.1	45.6
S1				34.6
S2		44.3	46.1	45.6
(iii) University-Secondary Teaching				
S0		52.8	52.2	52.8
S1				42.8
S2		52.8	52.2	52.8
B. Equipment				
(i) Primary-Secondary				
S0	69.0	158.1	44.4	74.7
S1	60.6	149.7	37.3	69.2
S2	64.5	188.8	177.9	124.8
(ii) Higher Secondary-Primary Teaching				
S0	5.2	8.0	8.1	8.0
S1	6.3	4.2	4.3	6.1
S2	5.2	8.0	8.0	8.0
(iii) University-Secondary Teaching				
S0	49.0	47.1	46.8	46.8
S1	49.0	28.5		31.6
S2	47.2	46.7	46.3	46.4

during the last period of the Plan. So compared with other solutions the proportion of the uneducated workers declines drastically among the farmers, as most of the additional primary graduates and dropouts are absorbed in this class. This not only raises the average educational qualification of the farmers by the end of the Plan, but because of the importance of the farmer group in the total labour force, the combined average years of education of the new labour force is also increased significantly above what were obtained in S0 and S1 (Appendix Table 38). Furthermore, since there was greater demand for higher secondary graduates to join as primary school teachers in S2, the educational composition of Clerical and sales workers as well as managerial workers turned out to be different in the sense that educational distribution in the clerical skill was less diversifed while that in managerial skill was more diversifed compared with S0 and S1.

Table 14 brings out explicitly the effect of enrolment constraints on the educational strategies underlying the three solutions. The general conclusion is that, under varying sociopolitical constraints primary education remain the most important component of the educational system of Bangladesh. Secondary education is the least emphasized. Furthermore, there is unmistakable evidence that, the higher secondary and the university enrolment should continue at a level considerably higher than the base period although, in the absence of socio-political constraint, the optimal strategy calls for a declining level of enrolment.

Larger enrolment in higher education implies that a greater proportion of the secondary level graduates should continue in higher education instead of joining either the labour or the teacher force.

It was pointed out before that, given the flow of foreign funds, a more stringent educational constraint than the basic model requires a greater domestic savings effort. This is reflected in the fact that while the capital constraint is binding only in the first two periods in S0 and S1, in the solution with universal primary enrolment (S2) it is also binding in the third period.

The magnitude of the shadow price of foreign exchange in different solutions is almost the same in all periods implying that the requirement for additional investment in education as called for in S0 and S2 as compared with S1 does not put any additional pressure on the foreign exchange resource of the region. In other words, there is a greater degree of substitutability between foreign exchange and domestic resources in the expansion of the educational facilities than what is possible in the expansion of the economy. The reason for this is that in the case of the latter, a considerable amount of foreign exchange is necessary not only to create new capacity but also to utilize the installed capacity due to non-competitive current import requirement. There is no such current demand on foreign exchange from the educational system.

TABLE 14

Enrolment Under Alternative Enrolment Constraints

(in 000)

	Period 1	Period 2	Period 3	Period 4
1. Primary				
S0	6242.4	7945.5	13562.1	11058.0
S1	6303.8	7657.1	13123.5	11535.3
S2	6244.3	7694.1	15081.8	19413.0
2. Secondary				
S0	568.4	389.0	389.0	389.0
S1	551.2	339.8	295.1	
S2	567.9	389.0	389.0	389.0
3. Higher Secondary				
S0	213.2	304.1	304.1	304.1
S1	255.7	245.3	265.7	230.7
S2	213.9	304.1	304.1	304.1
4. Primary Teaching				
S0	192.7			
S1	135.8	96.8		
S2	191.7			
5. Secondary Teaching				
S0				
S1				26.2
S2		1.8	1.8	1.8
6. University				
S0	1.0	115.3	115.3	115.3
S1	1.0	115.3	103.8	73.8
S2	1.0	114.0	114.0	114.0

From the discussion presented above on the alternative solutions under varying sociopolitical constraints, a few general observations are in order. First, a more straingent educational strategy does not necessarily involve high economic cost. According to the present model, a strategy of universal primary enrolment by the end of the Plan can be attained by sacrificing a marginal amount of total consumption over the next twenty years. Second, the alternative sets of enrolment constraints do not significantly change the pattern of growth of the economic sectors. Thus, the question of any serious reorganisation of the economy in order to accommodate the changes in the basic solution educational strategy does not arise at all. The major impact of the sociopolitical constraints remains mainly on the educational sectors. The different educational strategies examined have considerable effect on the formation of the labour force since they affect the number of graduates that are absorbed into the educational system (as the continuing students and teachers) and those allowed to join the labour force.

B. Effect of Variation of Foreign Fund

The availability of foreign fund is very closely linked with the availability of two basic resources, foreign exchange and capital. The rate of growth of the economy will be positively correlated with the level of the foreign fund provided that the other constraints, particularly the different types of skills, do not create an absolute

bottleneck to the process of growth. In general, a rise in the availability of the foreign fund is accompanied by a greater demand for various types of skills in order to support a higher level of activity in the different economic sectors. To a great extent the increased demand for skills is accommodated by adjustments in the educational composition of the new labour force.

The basic solution was obtained with an assumed incremental flow of the foreign fund of Tk. 2000 million per period. A number of alternative solutions have been obtained with different levels of incremental foreign fund. These levels range from 0 to Tk. 3000 million per period. The macro-economic results of the lower and upper bound of the range of foreign fund are presented along with the basic solution in Appendix Table 39.

As expected, the increase of the foreign fund from 0 to Tk. 3000 million per period raises the rate of growth of income from 5.0 per annum to 5.7 annum. Similarly, the annual compound rate of growth of consumption increases from 4.8 to 5.7. Thus, given the structure of demand within the economy, a rise in the level of foreign fund has comparatively more favourable effect on consumption than on income. This, however, is not very surprising since the objective function is the discounted present value of consumption. Comparing the value of the objective function for equal increments to foreign fund per period, one can see that the value increases, but each increment is slightly less than before. Compared with the

basic solution. In the no aid solution the value of the objective function is reduced by about 15 per cent. However, it is perhaps a little heartening that even if the present level of the foreign fund is not increased at all, per capita consumption of Bangladesh can still grow (by about 1.3 per cent per annum) although by not very m

It was observed that, in its role of providing capital, the foreign fund tends to substitute for domestic savings effort. This becomes clear from Appendix Table 39. In the no aid solution the expost saving rate is equal to the maximum exante rate (23 per cent) in all but the last period while at all positive levels of foreign fund increment, the saving constraint is binding only in the first two periods. Furthermore, in periods when the savings constraint is not binding, it is found that the higher the amount of foreign fund, the lower the level of domestic savings effort (i.e. the higher the level of consumption) as reflected in the marginal rate of savin To a great extent, however, the presence of unutilised savings potential is the direct result of the assumption of non substitutability (direct) among the various basic resources (different types of skill capital, and foreign exchange). It also shows that the possibility of indirect substitution is very limited.

The capital cost of the development programme in alternative foreign fund solutions does not reveal any significant trend in any period except in the first. In the first period, higher amounts of foreign fund are accompanied by low capital income ratio (incremental

The reason for this is that, availability of a greater amount of foreign exchange leads to a higher utilisation of the exogenously given capacity in various sectors in the first period. This is particularly true of those sectors which have a high requirement of non-competitive import (foreign and regional) per unit of output increment. For individual solutions, it is observed that at a moderate level of increment to foreign fund, there is a tendency to economise capital in earlier periods, but the trend is reversed when capital becomes a non-binding constraint. This result is changed at very high levels of increment to foreign fund in the sense that the incremental capital income ratio rises steadily over time - implying that a high rate of growth of the economy involves the expansion of the more capital intensive sectors.

The total labour output coefficient, declines as the amount of incremental foreign fund goes up. This reflects that at low levels of foreign fund the economy emphasizes those sectors which are more intensive in the use of labour relative to either foreign exchange or capital. In the context of the present model this result implies that at a low level of the foreign fund, the economy tends to utilise more of the less educated persons per unit of output than at a high level of foreign fund. This can be seen from the fact that in general, the educational qualification of the new labour force declines in alternative solutions with a declining amount of the foreign fund increment per period. However, in the first period the average years of education of the new labour force falls as the amount of

incremental foreign fund goes up. This requires some explanation. In this model the base period enrolment is exogenously given and hence the flow of graduates and dropouts in the first period are outside the control of the model. Now, of the solutions a substantial number of higher educated persons are drawn into the educational system as teachers (particularly in the primary level). Since the level of primary enrolment in the second and subsequent periods varies directly with the amount of foreign aid, the lower the latter the less is the number of higher level educational graduates and dropouts joining as teachers. So, the student flow equalities ensured that most of these high level graduates were absorbed into various types of skills. The natural consequence of the above was that a lower amount of foreign fund was accompanied by a higher average years of education of the new labour force.

The flow of the foreign fund also affects the rate of return to various types of education as reflected in the shadow prices of the graduates and dropouts presented in Appendix Table 40. An increase in the amount foreign fund increases the demand for various types of skills in order to support a higher rate of growth of the economy. To a great extent, the increased supply of skills comes through an upgrading of the educational qualification of the new labour force (Appendix Table 41). This will be profitable only if the rate of return to education increases as the foreign fund is increased. From Appendix Table 40, it is clear that a higher level of foreign

fund raises the productivity of education as it is shown that the higher the amount of the incremental foreign fund the higher are the shadow prices of the various types of graduates and dropouts.

The upgrading of the educational qualification of the new labour force as the amount of the foreign fund is increased, is reflected in the enrolment strategy in different solutions. In all of the post-primary levels, the enrolment figure goes up with the amount of foreign fund, particularly in the first two periods. In later periods, the second period enrolment levels are maintained through the additional enrolment constraints. As it can be seen from Table 15, the above trend is also found in the primary enrolment in all periods except the first when the movement of the enrolment levels is a little erratic.

C. An Experiment with Dropout Rate

In the basic model the dropout rates at various educational levels were exogenously given and they were held constant over the planning horizon. Contrary to the assumption made here, the dropout rate can be made a decision parameter so that the planners can adopt policy measures to reduce dropout rates. One policy measure would be to undertake additional expenditure on providing such facilities as will induce the students to continue in the school and will also reduce failure rates. The latter is important in the secondary and

TABLE 15

Primary Enrolment in Alternative Foreign Fund Solution

Alternative Levels of Foreign Fund Increment Per Period (Tk. Million)	Period 1	Period 2	Period 3	Period 4
0	5812.0	7717.0	6295.5	5026.4
1000	6264.5	5634.6	11923.4	9695.3
1400	6255.8	6139.9	13227.1	10777.9
1800	6246.9	7343.4	13450.4	10964.9
2000	6242.4	7945.2	13562.1	11058.0
2200	6242.1	8549.5	13673.3	11150.9
2600	6245.2	9779.9	13886.1	11328.9
3000	6219.9	12124.2	12061.1	9817.1

higher secondary levels since a large number of those who can not pass the final examination do not take it again. So, in terms of job opportunity, the entire duration of the course of study becomes a complete waste from the point of view of the student concerned.

It was stated in Section II that, in general, the problem of dropout rate is most serious in the primary level, where the average dropout rate is 77 per cent. What is very disconcerting about this is that most of these students leave the school system before completing four years of education, which is considered by many experts on education to be the minimum duration for which an individual must be in the school if he is to retain any benefit of education. So it appears that there may be a case for reducing the dropout rates through specific measures.

The additional expenditure for reducing the dropout rates may be related mainly to providing the following facilities at the various pre-University educational levels. (a) Supplying free text books in the primary and secondary levels. In the higher secondary level, these books can be provided at a subsidized price since usually the cost of printing of books is high for this stage. (b) Every school and college may be provided with library facilities. This, however, must be accompanied by teachers' making sure that the students are encouraged to utilize such facilities. (c) In the primary and secondary schools, free midday meals can be served. In the long hours of schooling during the day, usually a

hungry student is not capable of concentrating on his work after min
(d) There is a considerable scope for increasing sports and other
recreational facilities in all of these schools. This is particularly
important in the primary level, where these attractions may make the
school a more interesting place to be for an average student so that
he is likely to exert more effort to continue to enjoy the privileges
(e) The salary scales of teachers can be increased. This will make
teaching job more attractive than what it is at the present moment so
that people do not have to enter the teaching profession only as the
'dender of the last resort'. It is expected that this will improve
the quality of teaching, thus helping the students to be better
prepared to go through the rigour of the educational process. In
particular, this is certainly likely to reduce the present high rate
of mortality at the school final examinations. (f) Facilities for
in-service training of teachers can be created in order to ensure a
continued high quality of teaching.

The possibility of reducing the dropout rates at the pre-university educatio al levels by undertaking additional expenditures has been incorporated into the model in the following way. It is assumed that the dropout rate at the primary, secondary, and higher secondary level is a linear function of the per student additional expenditure at that level. Thus, in terms of the notation used in Section III,

$$g_p = a_p + b_p \frac{E_d^p}{N_p}$$

where,

g_p = Dropout rates from schools of type P;

N_p = Enrolment in schools of type P;

E_d^p = Additional expenditure to reduce dropout rate at level P;

P = 1, 2, 3

1 represents primary level,

2 represents secondary level,

3 represents higher secondary level.

a_p, b_p = Parameters of the dropout function.

In the basic model, the graduate and dropout flow equations for the primary, secondary, and higher secondary levels will be affected by this change. After necessary substitution, the flow equations presented in Section III stand as,

. for graduates

$$\rho_p (1 - g_p) N_p^{(t)} - \rho_p b_p E_d^p (t) - \sum_{q=1}^{6} C_{pq} N_{pq}(t) - \sum_{s=1}^{5} e_{ps} W_{ps}(t) - \sum_{r=1}^{6} f_{pr} T_{pr} = 0,$$

and for dropouts

$$\rho_p g_p N_p(t) + \rho_p b_p E_d^p (t) - \sum_{s=1}^{5} g_{ps} Z_{ps}(t) - \sum_{r=1}^{6} k_{pr} V_{pr}(t) = 0.$$

From the nature of this additional expenditure described above, it follows that it will lead to an additional demand for the output of two economic sectors, manufacturing A and services. To take accoun of the new component of demand, the following terms should be added to the balance equations of these sectors,

for Manufacturing A, $\sum_{p=1}^{3} a_p E_d^p(t) - \sum_{p=1}^{3} a_p E_d^p(t-1)$

and for services, $\sum_{p=1}^{3} a'_p E_d^p(t) - \sum_{p=1}^{3} a'_p E_d^p(t-1)$

where a_p, a'_p = Proportion of E_d^p spent on the output of manufacturing A and services respectively;

and $a_p + a'_p = 1$.

The most important aspect of this experiment is that it introduces a new element of choice into the basic model. It is now possible to increase the supply of graduates from the various pre-university educational levels either by increasing the enrolment or by reducing the dropout rate or by a combination of the two. The optimization process will determine which of the above is the most desirable strategy. A second important characteristic which should be emphasized is that it is no longer assumed that the dropout rate will remain constant over the entire planning horizon. The optimal strategy will determine the dropout rate in each period. However, it should be noted here that the dropout rate associated with the base period enrolment is given exogenously. So, the dropout rates to be affected

by this experiment are those associated with the first, second, and the third period enrolments. The corresponding additional expenditure will take place in the same period. Thus there /will be no variable corresponding to additional expenditure in the fourth period, since the conservation equalities for the graduates and dropouts for the fourth period enrolees are not included in this model.

For empirical implementation, it was assumed that $b_p < 0$ and $a_p = \overline{g_p}$, where $\overline{g_p}$ is the dropout rate in the base period at the level p. In the absence of any time series data to allow an econometric estimation of the parameter b_p for different educational levels, the following simple procedure was adopted to obtain tentative values of b_p to carry out the present experiment.

From MPEP (1969) it was found that the current recurring costs per student in different levels are as follows,

Primary = Tk. 95.00 per period

Secondary = Tk.365.00 per period

And higher Secondary = Tk. 970.00 per period.

On the basis of the above, it was assumed that for a 30 per cent reduction in the primary dropout rate, an additional expenditure of 25 per cent of the current recurring cost must be undertaken. The corresponding figures for both secondary and higher secondary levels were 20 and 10, respectively. These provided a second point in the two dimensional space with axes as g_p and $\frac{E_d^p}{N_p}$. The first point was,

of course, $(0, \bar{g}_p)$ implying that if no additional expenditure is undertaken, the dropout rate will remain at the base period level. The value of b_p was taken to be the slope of the straight line passing through these two points. The resultant estimates of b_p in the above three cases were

$b_{Primary} = -.00974,$

$b_{Secondary} = -.00119,$

and $b_{higher\ secondary} = -.0067.$

As for distribution of additional expenditure between the output of manufacturing A and services, the following figures were assumed as a first approximation.

$a_{primary} = .50,$ $\quad a'_{primary} = .50,$

$a_{secondary} = .75,$ $\quad a'_{secondary} = .25,$

$a_{higher\ secondary} = .75.$ $\quad a'_{higher\ secondary} = .25.$

In the analysis of results the basic solution is designated as D1 and the new dropout rate experiment is designated as D2. The The macro-economic results of the two solutions are presented in Appendix Table 42.

There is no difference in the rate of growth of income and consumption, but the value of the objective function is higher in D2 than in D1. This implies that it is profitable to undertake additional expenditure in order to reduce the dropout rates. The higher value of the objective function is obtained without any significant change in the mobilisation of the domestic savings as reflected in the marginal rate of saving. In point of fact, the capital cost of the development programme under D2 is almost the same in all periods. As in the basic solution, in D2 the model economises the use of capital during the first half of the planning horizon, but the trend is reversed in the second half. This is not surprising, since in this experiment, too, the capital constraint is not binding in the last two periods.

In aggregate terms the most significant effect of the dropout rate experiment is the upgrading of the educational qualification of the new labour force. It is apparent that the reduction of the dropout rates has increased the availability of graduates (particularly of the primary graduates) for the formation of different types of skills and thus raising the average years of education of the new labour force. In point of fact, in all periods the average years of education is higher in D2 than in D1. The difference is much greater in later periods than in earlier periods. This is explained by the fact that the graduates had to go through the duration of the educational process before they could be available to join the labour force. Thus, the substantial increase in the number of graduates in the new labour force did not take place until the third period.

An analysis of the investment pattern in education in alternative dropout rate solutions, as shown in Table 16 reveals that it is profitable to undertake additional expenditure to reduce the dropout rates during the second and third period in all pre-university educational levels. As expected, in these two periods the fixed investment in education is less in D2 than in D1. The excention to this is found in the case of higher secondary-primary teaching level where the investment level in both solutions are the same. This is due to the fact that the fixed investment in these levels is mainly incurred to meet the replacement demand only, since the enrolment in the secondary level declines over time, thus eliminating the need for any further addition to building and equipment capacity.

The investment pattern is changed considerably for primary and secondary level due to the introduction of flexible dropout rates. Compared with the basic solution, fixed investment is reduced drastically, while a large additional expenditure was undertaken in order to reduce dropout rate, particularly in the primary level. Correspondingly, the primary level enrolment declines after period 2 in the new dropout rate experiment and stands at almost half the level of the basic solution (Table 17). Furthermore, the lower level of university enrolment in D2 is explained by the fact that, because of a greater supply of the primary, secondary, and higher secondary graduates, through reduced dropout rates, the need for university graduates for the formation of various skills declined.

From the shadow prices of the basic resources, as presented in Table 18, one can see that the new dropout rate experiment leads to a higher productivity of foreign exchange and capital while the productivity of the different types of skill declines. The reason for this is that, with the availability of more graduates and dropouts both capital and foreign exchange become relatively scarce while skills become relatively abundant. However, there is no significant change in the relative scarcity of capital and foreign exchange between the two solutions. The relative abundance of the various skills is also reflected in the rates of return to different types of education. From Table 19, it is clear that the productivity of the different types of education is less in D2 than in D1 in all planning periods as shown by a lower shadow price of graduates and dropouts in the former as compared with the latter.

The outcome of the dropout rate experiment, in spite of involving some arbitrary estimation of parameters, indicates that there is a case for reducing the dropout rate through additional expenditure on new facilities, which are expected to bring about an all-round improvement in the quality of education. On the one hand, it helps reduce the waste of education which goes on along with a high rate of the different types of skills by increasing the supply of graduates who have a greater productivity than dropouts in all skills.

TABLE 16

Investment in Education in Alternative Dropout Rate Solutions

(Tk. Million)

	Period 1	Period 2	Period 3	Period
1. Fixed Investment				
(i) Primary-Secondary				
D1	387.4	1133.3	44.4	4050.1
D2	613.8	33.1	26.9	4643.4
(ii) Higher Secondary Primary Teaching				
D1	5.2	52.3	54.2	53.8
D2	5.2	52.3	54.2	53.8
(iii) University-Secondary Teaching				
D1	49.0	99.9	99.0	99.8
D2	20.9	92.9	91.9	92.6
2. Expenditure on Reduction of Dropout Rates				
(i) Primary				
D1				
D2	0	762.5	627.2	
(ii) Secondary				
D1				
D2	0	55.6	55.6	
(iii) Higher Secondary				
D1				
D2	0	147.4	147.5	

TABLE 17

Enrolment in Alternative Dropout Rate Solution

(in 000)

	Period 1	Period 2	Period 3	Period 4
1. Primary				
D1	6242.4	7945.2	13562.1	11058.0
D2	6265.7	9632.2	7923.9	6418.6
2. Secondary				
D1	568.4	389.0	389.0	389.0
D2	561.9	304.8	304.8	304.8
3. Higher Secondary				
D1	213,2	304.1	304.1	304.1
D2	272.7	304.1	304.1	304.1
4. Primary Teaching				
D1	192.7			
D2	113.1			
5. Secondary Teaching				
D1				
D2		28.8	28.8	28.8
6. University				
D1	1.0	115.3	115.3	115.3
D2	1.0	93.7	93.7	93.7

TABLE 18

Shadow Prices of Basic Resources in Alternative Dropout Rate Solution

	Period 1	Period 2	Period 3	Peri
1. Skill constraints				
(i) Farmer				
D1	0	.001	0.12	1.0
D2	0	.008	.0004	0.7
(ii) Manual				
D1	0	0	0.26	1.3
D2	0	.07	0	1.0
(iii) Clerical and Sales				
D1	0	.002	0.34	2.8
D2	0	0	.004	2.2
(iv) Administrators and Managers				
D1	2.55	0.29	0.52	4.3
D2	1.76	0.16	.007	3.3
(v) Professionals and Technicians				
D1	2.72	0.58	0.41	3.3
D2	1.92	0.02	0	2.9
2. Foreign Exchange				
D1	1.94	1.39	0.97	0.9
D2	1.95	1.41	0.98	0.9
3. Capital				
D1	1.48	0.29	0	0
D2	1.55	0.32	0	0
4. Foreign Fund				
D1	3.42	1.68	0.97	0.9
D2	3.50	1.73	0.98	0.9

TABLE 19

Shadow Prices of Graduates and Dropouts in Alternative Dropout Rate Solution

	Period 1	Period 2	Period 3	Period 4
1. Primary Graduate				
D1	-0.29	0.31	0.31	0.20
D2	-0.20	0.21	0.21	0.16
2. Primary Dropout				
D1	-0.21	0.22	0.23	0.21
D2	-0.15	0.16	0.24	0.18
3. Secondary Graduate				
D1	-0.45	0.48	1.10	0.62
D2	-0.31	0.33	0.71	0.48
4. Secondary Dropout				
D1	-0.34	0.36	0.38	0.33
D2	-0.24	0.25	0.90	0.64
5. Higher Secondary Graduate				
D1	-3.86	0.74	0.67	0.62
D2	-2.63	0.47	0.47	0.48
6. Higher Secondary Dropout				
D1	-0.45	0.48	0.50	0.46
D2	-0.31	0.33	0.80	0.75
7. Primary Teaching Graduate				
D1	---	0.65	0.67	*
D2	---	0.43	*	*
8. Primary Teaching Dropout				
D1	---	0.48	0.50	0.46
D2	---	0.33	0.35	0.36
9. Secondary Teaching Graduate				
D1	*	*	*	*
D2	*	*	*	*

Note: (1)*Indicates that the constraint is binding but the shadow price is zero, implying that alternative optima exists.

VII. Summary of Conclusions

As pointed out in Section I, the planning models for Banglade developed in the past failed to recognize the fact that a skill sho age could have emerged as a bottleneck to the process of growth. T main emphasis in planning was on the efficient utilization of forei exchange and capital. This approach, therefore, rested on the assu tion that the required amount of labour skills would always be ava The major emphasis in this paper has been placed on examining the importance of skill constraints for economic growth and also on sho that it is extremely important to study the interaction of the econ and the educational system, the latter deriving its importance from the fact that it provides inputs (graduates and dropouts) into vari types of skills.

The fallacy of ignoring the skill constraint in a planning model originated because labour was treated as a homogenous factor production and the existing evidence of unemployment and under-employment among certain types of skill was taken to be an indicati of a surplus labour economy with a zero opportunity cost of labour. A further assumption, implicit in the treatment of the skills ment-ioned above, was that the process of the formation of a skill was completely exogenous to the economic system. Thus, it was not clea how the demand for various skills originating from the economic activities would transmit itself to the educational system in a manner which will ensure a balanced supply of graduates and dropou in order to produce the necessary skills.

In this paper, it is shown that for Bangladesh, during the planning horizon under consideration, various types of skill emerge as relatively scarce factors of production. In the latter two periods there is a shortage of lower level skills (farmer, manual workers, and clerical workers), and the higher skills (managerial workers, and technical workers) create bottlenecks in all planning periods. These factors seriously affect the allocation decisions in the economic sectors as well as the overall level of operation of the economy. So, the outcome of a planning exercise which assumes that the opportunity cost of all types of skill is zero is likely to be grossly misleading. The bottleneck due to the shortage of the different types of skill is experienced under alternative assumptions about the sociopolitical constraints as well as the incremental flow of foreign fund except when the latter is at a very low level.

The enrolment constraints which were incorporated in order to reflect some sociopolitical considerations affect significantly the pattern of skill scarcity over time. As expected, a more stringent requirement tends to raise the scarcity of higher level skills because a larger number of graduates remains within the educational system either as continuing students or as teachers.

The flow of the foreign fund, when at a very low level, le to a situation in which foreign exchange and capital become the nant constraints, and the productivity of all types of skills is reduced to zero. However, the importance of the skill constrain increases as the amount of the incremental foreign fund is raise

The treatment of skills in terms of efficiency units brin out an important fact when viewed over a wide range of increment foreign fund. It is found that the adjustment to the skill sca is carried out through changing the educational composition of t labour force. Consequently, a higher level of incremental fore fund has been accompanied by an increase in the average years o education of the new labour force. But the process of adjustme through the educational distribution of the new labour force ca carried out only up to a limited extent. Beyond a certain poin given the values of the basic parameters (e.g., dropout rates, tive productivity coefficients), the structure of education bec an important bottleneck, and any change in the educational comp of the labour force becomes impossible.

An interesting example of the interaction between the educational and economic strategies is revealed by the fact tha while a greater emphasis on educational expansion does not chan relative scarcity of foreign exchange, it affects the relative of capital in a way that a greater mobilisation of domestic res becomes inevitable.

The educational strategy, reflected primarily through the enrolment pattern, reveals that irrespective of the nature of the socio-political constraints as well as the flow of foreign fund, the primary education is the most important component of the educational system of Bangladesh. In general, under a more favourable flow of foreign fund, the enrolment goes up in all levels, but most significantly so in the primary level. It is, however, observed that unless a specific constraint is included to ensure universal primary enrolment by a certain period, the model does not undertake such a programme even with a very generous level of foreign fund. A very reassuring finding of the enrolment experiments is that a more stringent enrolment requirement, including the universal primary enrolment by the end of the Plan, does not involve a large sacrifice in terms of the objective of the model. It also follows that the more rigid sociopolitical requirement increases the availability of the graduates and dropouts, so that in the formation of the new labour force the educational input per worker is increased, a result similar to that of the increasing flow of foreign und.

One of the important contributions of this study has been to show that it is desirable to reduce the dropout rates at the pre-university levels of education (primary, secondary, and higher secondary). A reduction in the dropout rates leads to a reduction in the wastes in education and consequently a greater amount of resources is available for investment in the economy, thus raising the income and consumption.

It is found that the introduction of the possibility of reducing the dropout rate changes the nature of investment in education. The emphasis is shifted from fixed investment to investment in providing facilities for the reduction of dropout rate. Thus, a substantial part of the demand for pre-university level graduates is met by reducing the dropout rate than by increasing the enrolment. Since a reduction in the dropout rate leads to an increase in the number of graduates, the average educational qualification of the new labour force is raised above the level obtained in cases where this choice element is not introduced.

A more important finding is that it is possible to reduce the relative scarcity of all skills by reducing the dropout rate at different educational levels. In this case, foreign exchange becomes the dominant constraint to economic growth. So, in a situation like this, further growth of income and consumption can take place only through an expansion of the export possibility or a reduction of the non-competitive import requirement per unit of output.

APPENDIX

TABLE 1

ENROLMENT, TEACHER STOCK AND TEACHER-STUDENT RATIO IN BANGLADESH EDUCATIONAL SYSTEM, 1964-65

	Enrolment[b] (000)	No. of Teachers[c]	Student/ Teacher Ratio[c]
1. Primary[a]	4472.1	104480	43
2. Secondary[a]	955.5	37934	25
3. Higher Secondary	83.9	3479	24
4. Primary Teaching	8.5	454	19
5. Secondary Teaching	1.2	59	20
6. University	48.5	2546	19

Notes and Sources:

a) Includes religious (Madrasah) education.

b) Figures are taken from Table 1 in the text.

c) Source explained in the text.

PERMISSIBLE STUDENT FLOW

	Primary	Secondary	Higher Secondary	Primary Teaching	Secondary Teaching	University
1. Primary	1	1	0	0	0	0
2. Secondary	0	1	1	1	0	1
3. Higher Secondary	0	0	1	0	1	1
4. Primary Teaching	0	0	0	1	0	0
5. Secondary Teaching	0	0	0	0	1	0
6. University	0	0	0	0	0	1

Note: Permissible flow indicated by 1.

Diagonal elements represent repeaters.

TABLE 3

PERMISSIBLE TEACHER FLOW

	Primary	Secondary	Higher Secondary	Primary Teaching	Secondary Teaching	University
1. Primary Graduate	0	0	0	0	0	0
2. Primary Dropout	0	0	0	0	0	0
3. Secondary Graduate	0	0	0	0	0	0
4. Secondary Dropout	0	0	0	0	0	0
5. Higher Secondary Graduate	1	0	0	0	0	0
6. Higher Secondary Dropout	0	0	0	0	0	0
7. Primary Teaching Graduate	1	0	0	0	0	0
8. Primary Teaching Dropout	0	0	0	0	0	0
9. Secondary Teaching Graduate	0	1	0	1	0	0
10. Secondary Teaching Dropout	1	0	0	0	0	0
11. University Graduate	1	1	1	1	1	1
12. University Dropout	1	0	0	0	0	0

Note: Permissible flow is indicated by 1.

TABLE 4

ESTIMATED BASE PERIOD INVESTMENT, INITIAL STOCK OF EDUCATIONAL FACILITY, BUILDING-STUDENT AND EQUIPMENT-STUDENT RATIO, BANGLADESH 1964-65

(Tk. Million)

	Building Stock	Equipment Stock	Building/ Student Ratio	Equipment/ Student Ratio	Investment in Building	Investment in Equipment
1. Primary	475.17	60.86	106	14	178.08	23.52
2. Secondary	327.60	56.67	339	59	141.43	9.43
3. Higher Secondary	184.60	12.09	2306	160	169.45	12.30
4. Primary Teaching	33.56	2.87	3496	299	15.38	1.32
5. Secondary Teaching	6.89	.49	5721	402	6.58	.46
6. University	365.74	122.09	7629	2698	207.23	60.56

TABLE 5

DROPOUT RATES, LEAKAGE RATES AND AVERAGE LENGTH OF STUDY AT DIFFERENT EDUCATIONAL LEVELS, BANGLADESH

	Dropout Rate %	Leakage Rate %	Average[a] Length of Study
Primary	77.12	.60	6.4 (1.3)
Secondary	21.65	.23	5.5 (1.1)
Higher Secondary	32.58	.34	2.6 (.5)
Primary Teaching	12.00	.34	1.0 (.2)
Secondary Teaching	2.00	.38	3.0 (.6)
University	20.36	.38	3.0 (.6)

Notes:

a) Average length is expressed in years. Figures within parenthesis represents the average length of study as a fraction of one planning period.

TABLE 6

SURVIVORSHIP RATES OF TEACHERS

	Survivorship in Per Cent up to Period				
	Period 0	Period 1	Period 2	Period 3	Period 4
Initial Stock					
(i) Primary	100.00	97.12	92.26	87.65	83.27
(ii) Others	100.00	96.82	91.98	87.38	83.01
New Entrants In					
(i) Period 1		100.00	97.50	94.33	90.79
(ii) Period 2			100.00	97.50	94.33
(iii) Period 3				100.00	97.50
(iv) Period 4					100.00

TABLE 7

SCHOOL AGE POPULATION CONSTRAINT

(in 000)

Period 1	11110
Period 2	14101
Period 3	16806
Period 4	19413

TABLE 8

INDUSTRIAL DISTRIBUTION OF LABOUR FORCE OF BANGLADESH 1964-65

	Value Added 1965 (In Tk.Million)	Value Added Per Worker 1961	Assumed Annual Growth Rate of Value Added Per Worker	Value Added Per Worker 1965	Employment 1965
1.Agriculture	10774	640	2.0	693	15569360
2. Manufacturing	1536	1344	4.5	1603	958203
3. Construction	806	2170	2.5	2395	336534
4. Electricity and Gas	113	1990	6.0	2512	44989
5. Transport	1188	5030	2.0	5444	218423
6. Trade	2218	2974	2.0	3219	689677
7. Services					
(i) Finance, Real Estate, Govt., etc.	1972	12897	2.0	13929	141575
(ii) Other Services	810	932	1.5	989	819009

TABLE 9

OCCUPATIONAL PATTERN IN LABOUR FORCE BANGLADESH, 1964-65.

(in percentage)

	Farmers	Manual	Clerical and Sales	Administrators and Managers	Professionals and Technicians	Total
1. Agriculture	97.36	2.64	--	--	--	100.00
2. Manufacturing	--	95.68	2.00	1.00	1.32	100.00
3. Construction	--	89.59	3.00	3.40	4.01	100.00
4. Electricity and Gas	--	73.80	21.70	0.70	3.80	100.00
5. Transport	--	87.14	10.30	1.20	1.36	100.00
6. Trade	--	4.60	91.02	3.90	0.48	100.00
7. Services						
(i) Finance, Real Estate, Govt., etc.	--	10.70	79.10	7.30	2.90	100.00
(ii) Other Services	--	63.10	15.60	1.30	20.00	100.00

TABLE 10

OCCUPATIONAL DISTRIBUTION OF LABOUR

	Farmers	Manual	Clerical and Sales
1. Agriculture	15158329	411031	---
2. Manufacturing	---	916809	19164
3. Construction	---	301501	10096
4. Electricity & Gas	---	33198	9762
5. Transport	---	190334	22498
6. Trade	---	35725	627744
7. Services			
(i) Finance, Real Estate, Govt., etc.	---	531943	239751
	---	15148	111086
(ii) Other Services	---	516795	127765
Total	15158329	2420542	929015

FORCE BY SECTORS 1964-65

Administrators and Managers	Professionals and Technicians	Total
---	---	15569360
9582	12648	958203
11442	13495	336534
315	1709	44984
2621	2971	218423
26897	3310	689677
20982	167908	960584
10355	4106	141575
10647	163802	819009
71839	202041	

TABLE 11

INITIAL STOCK OF LABOUR FORCE BY SKILL EXPRESSED IN EFFICIENCY UNITS

(in 000)

1. Farmers	3931.51
2. Manual	559.12
3. Clerical and Sales	123.60
4. Administrators and Managers	9.15
5. Professionals and Technicians	20.51

Notes:

a) All figures include unemployed persons.

b) Farmers and Manual Workers include new entrants from among uneducated people.

TABLE 12

LABOUR OUTPUT COEFFICIENTS
(THOUSAND WORKERS PER 1 MILLION TAKAS WORTH OF OUTPUT)

	Agriculture	Manufacturing A	Manufacturing B	Construction	Electricity and Gas	Transport	Trade	Services
Farmers	.1812 (.0400)	---	---	---	---	---	---	---
Manual	.0049 (.0008)	.0326 (.0053)	.0326 (.0053)	.0236 (.0038)	.0403 (.0065	.0314 (.0051	.0030 (.0005	.0361 (.0058)
Clerical and Sales	---	.0007 (.0001)	.0007 (.0001)	.0008 (.0001)	.0118 (.0012)	.0037 (.0004)	.0521 (.0052)	.0163 (.0016)
Administrators and Managers	---	.0003 (.0001)	.0003 (.0001)	.0009 (.0001)	.0004 (.0001)	.0004 (.0001)	.0022 (.0002)	.0014 (.0001)
Professionals and Technicians	---	.0005 (.0001)	.0005 (.0001)	.0011 (.0001)	.0021 (.0002)	.0005 (.0001)	.0003 (.0001)	.0114 (.0011)

Notes: A) Figures in parenthesis are expressed in efficiency units.

TABLE 13

ESTIMATED UNEMPLOYED AND UNEDUCATED WORKERS IN THE BASE PERIOD

	Unemployed	Uneducated (in 000)
1. Farmers	2476	2694
2. Manual	860432	142
3. Clerical and Sales	316936	--
4. Administrators and Managers	51997	--
5. Professionals and Technicians	6190	--

TABLE 14

SURVIVORSHIP RATES OF INITIAL LABOUR FORCE
(in percentage terms)

Age	1961 Proportion of the Total (in %)	Survivorship in Period up to 1	2	3	4
10-14	10.20	97.50	93.11	88.45	84.03
15-19	10.84	95.50	90.73	86.19	80.59
20-24	11.57	95.00	90.25	84.38	78.05
25-34	24.42	93.50	86.49	77.84	68.11
35-44	18.17	90.00	78.75	65.36	43.13
45.54	12.80	83.00	54.78	29.31	-
55-59	3.75	66.00	35.31	-	-
60 +	8.24	53.50	-	-	-
Average		87.98	75.34	62.77	50.81

TABLE 15

LABOUR FORCE SURVIVORSHIP RATE
(IN PERCENTAGE TERMS)

	Survivorship up to Period				
	0	1	2	3	4
Initial Stock	100.00	87.98	73.54	62.77	50.81
Entrants in Period					
1		100.00	96.25	91.68	86.41
2			100.00	96.25	91.68
3				100.00	96.25
4					100.00
Uneducated Workers Entering Labour Force in Period					
1	100.00	97.50	93.11	88.45	84.03
2		100.00	97.50	93.11	88.45
3			100.00	97.50	93.11
4				100.00	97.50

TABLE 15a

PERMISSIBLE SKILL FLOW

	Farmers	Manual	Clerical and Sales	Administrators and Managers	Professionals and Technicians
1. Illiterate	1	1	0	0	0
2. Primary Graduate	1	1	1	1	1
3. Primary Dropout	1	1	1	1	1
4. Secondary Graduate	0	1	1	1	1
5. Secondary Dropout	1	1	1	1	1
6. Higher Secondary Graduate	0	0	1	1	1
7. Higher Secondary Dropout	0	0	1	1	1
8. Primary Teaching Dropout	0	0	1	0	0
9. Secondary Teaching Dropout	0	0	0	1	0
10. University Graduate	0	0	0	1	1
11. University Dropout	0	0	0	1	1

Note: Permissible flow indicated by 1.

TABLE 16

RELATIVE PRODUCTIVITY COEFFICIENTS

	Farmers	Manual	Clerical and Sales	Administrators and Managers	Professional and Technicians
1. Illiterate	.2174	.1512			
2. Primary Graduate	.2826	.2093	.0989	.0515	.0579
3. Primary Dropout	.2174	1512	.0769	.0412	.0474
4. Secondary Graduate	--	.2442	.1648	.1030	.1053
5. Secondary Dropout	.2826	.2442	.1099	.0619	.0789
6. Higher Secondary Graduate	--	--	.2197	.1443	.1579
7. Higher Secondary Dropout	--	--	.1648	.1030	.1053
8. Primary Teaching Graduate	--	--	.1648	--	--
9. Secondary Teaching Dropout	--	--	--	.1443	--
10. University Graduate	--	--	--	.2062	.2632
11. University Dropout	--	--	--	.1443	.1842

TABLE 17

BANGLADESH INCREMENTAL INPUT-OUTPUT TABLE (8 x 8)
(IN 1964-65 PURCHASER'S PRICES)

	1	2	3	4	5	6	7	8
1. Agriculture	.09274	.27780	.05612	.11037	. 0	.00600	0	.00072
2. Manufacturing A	.00159	.14796	.04951	.00663	.00403	.00961	.00156	.00441
3. Manufacturing B	.02290	.05270	.27154	.19939	.18284	.05240	.00232	.00448
4. Construction	0	0	0	0	0	0	0	.10963
5. Electricity and Gas	.00046	.01766	.02446	0	.05588	.00209	.00188	.00738
6. Transport	.03205	.02749	.05501	0	0	0	0	.02376
7. Trade	.05702	.08695	.09610	0	0	0	0	0
8. Services	.00052	.01077	.01292	.00518	.00327	.00598	.00514	.02694
9. Total	.20728	.62133	.56566	.32157	.24602	.07608	.01090	.17732
Value Added Coefficient	.79272	.37867	.43434	.67843	.75398	.92392	.98910	.82268

TABLE 18

INCREMENTAL FIXED CAPITAL COEFFICIENT PER PERIOD

	Agri-culture	Manu-facturing A	Manufa-cturing B	Cons-truction	Electri-city and Gas	Trans-port	Trade	Services
3. Manufacturing B	.0409	.0920	.1732	.0282	.6996	.1986	.0570	.0325
4. Construction	.0283	.0396	.0893	.0020	.4664	.2412	.2274	.5774
Incremental capital/ Output Ratio	.0692	.1316	.2625	.0302	1.1660	.4398	.2844	.6099

TABLE 19

WORKING CAPITAL REQUIREMENT PER UNIT OF INCREASE IN OUTPUT AND FINAL DEMAND

	Agriculture	Manufacturing A	Manufacturing B	Construction	Electricity and Gas	Transport	Trade	Service	Final Demand
1. Agriculture	.07365	.11550	.02393	.19391	---	.00090	---	.00011	.150
2. Manufacturing A	.00013	.06057	.02644	.01630	.00150	.00192	.00026	.00075	.152
3. Manufacturing B	.00834	.02152	.25538	.62068	.07204	.01022	.00029	.00780	.180
Total	.08212	.19759	.30575	.83089	.07354	.01304	.00055	.00866	

	Agri-culture	Manu-facturing A	Manu-facturing B
1. Agriculture	.01053	.01067	.01099
2. Manufacturing A	---	.02482	---
3. Manufacturing B	---	---	.49924
4. Construction	---	---	---
5. Electricity and Gas	---	---	---
6. Transport	---	---	---
7. Trade	---	---	---
8. Services	---	---	---

TABLE 20

Construction	Electricity and Gas	Transport	Trade	Services	Final Demand
---	---	---	---	---	.00130
---	---	---	---	---	.00150
---	---	.00010	---	---	.00070
---	---	---	---	---	---
---	---	---	---	---	---
---	---	.03000	---	---	---
---	---	---	---	---	---
---	---	---	---	.00178	

TABLE 21

NON-COMPETITIVE INCREMENTAL REGIONAL (FROM PAKISTAN) IMPORT COEFFICIENTS

	Agriculture	Manufacturing A	Manufacturing B	Final Demand
1. Agriculture	.01264	.05505	--	.00070
2. Manufacturing A	--	.04467	--	.00100
3. Manufacturing B	--	--	.06919	--

TABLE 22

MARGINAL CONSUMPTION PROPORTIONS AND TRADE/ TRANSPORT COEFFICIENTS ON IMPORTS

	Marginal consumption Proportion	Foreign Import		Import from Pakistan	
		Trade coeffi-cient	Transport Coeffi-cient	Trade Coeffi-cient	Transport Coefficient
1. Agriculture	.4480	.1768	.0314	.2607	.0274
2. Manufacturing A	.2300	.2434	.0187	.0799	.0268
3. Manufacturing B	.0890	.2752	.0536	.0831	.0294
4. Construction	--				
5. Electricity and Gas	.0050				
6. Transport	.0370				
7. Trade	--				
8. Services	.1910				

TABLE 23

MACRO-ECONOMIC AGGREGATES FOR THE BASE PERIOD
(in Tk. Million)

1. Gross Regional Product	114077.5
2. Consumption	97237.6
(i) Private	93621.6
(ii) Public	3616.0
3. Investment	
(i) Gross	20818.4
(ii) Net	18712.9
(iii) Replacement	2105.5
4. Net Investment in	
(i) Economy	12884.6
(ii) Education	825.8
(iii) Working	5002.5
5. Exports	9021.0
(i) Foreign	6340.5
(ii) Regional	2680.5
6. Imports	12999.5
(i) Foreign	8717.5
(ii) Regional	4282.0
7. Capital Inflow	3978.5

TABLE 24

BASE PERIOD INVESTMENT BY SECTOR OF ORIGIN
(in Tk. Million)

	Net Fixed Investment			Working Capital	Replac
	Total	Economy	Education		
Agriculture	--	--	--	766.0	--
Manufacturing A	--	--	--	1472.5	--
Manufacturing B	4039.1	3931.5	107.6	2764.0	107
Construction	9671.3	8953.1	718.2	--	102
Total	13710.4	12884.6	825.8	5002.5	210

Note: a) Total replacement expenditure was divided between Manufacturing B and Construction on the basis of the proportions obtained from McEwan's (1968) base ye (1964-65) figure.

TABLE 25

NEW CAPACITY CREATION BY SECTOR IN BASE PERIOD AND INVESTMENT BY SECTOR AND ORIGIN
(in Tk. Million)

	New Capacity for Period 1 I (0)	Investment in Manufacturing B K_3 (0)	Investment in Construction K_4 (0)
1. Agriculture	18131.0	741.6	513.1
2. Manufacturing A	10697.5	285.7	122.4
3. Manufacturing B	9263.5	819.9	422.7
4. Construction	7532.0	212.4	15.1
5. Electricity and Gas	674.5	475.4	316.9
6. Transport	3697.5	734.3	891.8
7. Trade	6485.5	369.7	1474.8
8. Services	8999.5	292.5	5196.3

Note: a) Investment figures for Manufacturing A and Manufacturing B are adjusted for full capacity utilization. In 1964-65, the rate of capacity utilization was 87.5, and 59.6 per cent respectively. Capacity utilization figures are obtained from, Memorendum to Mr. Qamrul Islam and Mr. Ikhtiarul Mulk from Mr. Wouter Tims, Planning Commission, April 20, 1967.

TABLE 26

RATES OF DEPRECIATION BY SECTOR
(in percentage loss of output per period)

Sectors	Useful Life Per Unit Capacity	Depreciation Per Period
1. Agriculture	26	19
2. Manufacturing A	30	17
3. Manufacturing B	25	20
4. Construction	15	33
5. Electricity and Gas	26	19
6. Transport	27	19
7. Trade	35	14
8. Services	39	13
9. Primary/Secondary		
(i) Building	30	17
(ii) Equipment	15	33
10. Higher Secondary/Primary Teaching		
(i) Building	40	13
(ii) Equipment	15	33
11. University/Secondary Teaching		
(i) Building	50	10
(ii) Equipment	20	25

TABLE 27

LIMITS ON INCREMENT TO PRIVATE AND GOVERNMENT CONSUMPTION
(in Tk. Million)

	Private	Government
Period 1	17600.7	904.0
Period 2	20905.6	1130.0
Period 3	24837.7	1412.5
Period 4	29507.2	1765.6

TABLE 28

LIMITS ON INCREMENT TO EXPORTS
(in Tk. Million)

	Period 1		Period 2		Period 3		Period 4	
	Foreign Exports	Exports to Pakistan	Foreign Exports	Exports to Pakistan	Foreign Exports	Exports to Pakistan	Foreign Exports	Exports to Pakistan
1. Agriculture	638.0	503.2	894.8	739.2	1255.0	1086.4	1760.1	1596.4
2. Manufacturing A	1786.5	629.0	2505.5	942.2	3514.0	1358.0	4928.4	1995.2
3. Manufacturing B	127.6	125.8	179.0	184.8	251.0	271.6	352.1	399.1

TABLE 29

INCREMENTAL PRODUCTION PER PERIOD BY SECTOR IN THE BASIC SOLUTION
(Tk. Million)

	Period 1	Period 2	Period 3	Period 4
1. Agriculture	18131.0	26338.2	31466.5	46254.2
2. Manufacturing A	10243.0	14170.9	17956.4	25838.4
3. Manufacturing B	5863.9	3622.3	2835.4	883.3
4. Construction	1377.1	5069.5	5984.2	7885.8
5. Electricity-Gas	556.5	657.5	779.6	1031.6
6. Transport	2522.9	3393.0	4141.4	5725.0
7. Trade	4405.6	5693.7	7113.3	9651.7
8. Services	6308.5	8726.6	10834.6	15165.7
9. Total	49408.5	67671.7	81111.4	112435.7

TABLE 30

TOTAL PRODUCTION PER PERIOD BY SECTOR IN THE BASIC SOLUTION
(Tk. Million)

	Period 0	Period 1	Period 2	Period 3	Period
1. Agriculture	83671.5	101802.5	128140.7	159607.2	205861.4
2. Manufacturing A	21415.0	31658.0	45828.9	63785.3	89623.7
3. Manufacturing B	6682.5	12546.4	16168.7	19004.1	19887.4
4. Construction	12794.0	14171.1	19240.6	25224.8	33110.6
5. Electricity and Gas	824,5	1381.0	2038.5	2818.1	3849.7
6. Transport	6056.5	8579.4	11972.4	16113.8	21838.8
7. Trade	12041.5	16447.1	22140.8	29254.1	38905.8
8. Services	14741.0	21049.5	29776.1	40610.7	55776.4
9. Total	158226.5	207635.0	275306.7	356418.1	468853.8

TABLE 31

BASIC SOLUTION INCREMENTAL VALUE ADDED BY SECTOR

(Tk. Million)

	Period 1	Period 2	Period 3	Period 4
1. Agriculture	14372.8	20878.8	24944.1	36666.6
2. Manufacturing A	3878.7	5366.1	6799.5	9784.2
3. Manufacturing B	2546.9	1573.3	1231.5	383.7
4. Construction	934.3	3439.3	4059.9	5350.0
5. Electricity - Gas	419.6	495.7	587.8	777.8
6. Transport	2331.0	3134.9	3826.3	5289.4
7. Trade	4357.6	5631.6	7035.8	9546.5
8. Services	5189.9	7179.2	8913.4	12476.5

TABLE 32

BASIC SOLUTION INCREMENTAL PRIVATE CONSUMPTION
(Tk. Million)

	Period 1	Period 2	Period 3	Period 4
A Total	26200.2	37103.0	46120.7	65852.9
B. Sectoral				
1. Agriculture	11737.7	16622.1	20662.1	29502.0
2. Manufacturing A	6026.0	8533.7	10607.8	15146.2
3. Manufacturing B	2331.8	3302.2	4104.7	5860.9
4. Construction				
5. Electricity-Gas	131.0	185.5	230.6	329.3
6. Transport	969.4	1372.8	1706.5	2436.6
7. Trade				
8. Services	5004.3	7086.7	8809.1	12577.9
Rate of Growth (Over the Previous Period)				
Total Consumption	28.0	31.0	29.4	32.4
Annual Rate of Growth	5.0	5.4	5.2	5.7

Annual Compound Rate of Growth = 5.4

Over the Entire Planning Period.

TABLE 33

BASIC SOLUTION INDUSTRIAL DISTRIBUTION OF LABOHR FORCE (in Efficiency Units)

	Period 0	Period 1		Period 2		Period 3		Period 4	
		New	Total	New	Total	New	Total	New	Total
1. Agriculture	3407340	739745	4147085	1074599	5221684	1283833	6505517	1887171	8392688
2. Manufacturing A	119926	57360	177286	79357	256643	100557	357200	144696	501896
3. Manufacturing B	36664	32837	69501	20284	89785	15879	105664	4945	110609
4. Construction	51897	5647	57544	20785	78329	24534	102863	32333	135196
5. Electricity-Gas	6524	4452	10976	5261	16237	6237	22474	8252	30726
6. Transport	33477	14380	47857	19339	67196	23606	90802	32634	123436
7. Trade	70359	26434	96793	34162	130955	42680	173635	57910	231545
8. Services	127835	54253	182088	75048	257136	93177	350313	130425	480738
Grand Total	3854022	935108	4789130	1328835	6117965	1590503	7708468	2298366	10006834

TABLE 34

YEARS OF EDUCATION OF THE TOTAL LABOUR FORCE BY SKILL IN THE BASIC SOLUTION

	Period 0		Period 1		Period 2		Period 3		Period 4	
	Average	Total	Average	Total	Average	Total	Average	Total	Average	Total
1. Farmer	0.20	3685	0.70	13566	1.10	25906	1.38	40826	1.82	69809
2. Manual	2.70	8859	3.30	12154	4.05	18218	4.53	26104	5.12	38380
3. Clerical and Sales	5.20	6479	6.19	8498	6.67	10291	5.92	13023	5.30	16701
4. Administrators and Managers	6.50	806	6.78	786	8.55	1326	10.0	1728	11.02	2369
5. Professionals and Technicians	8.00	1664	8.94	2476	6.62	3199	7.81	4124	9.17	5422
6. Total for All Skill	1.07	21493	1.50	37480	1.95	58940	2.24	85805	2.67	132681

Notes : (1) Total figures are in thousand man years of education.

(2) 'Average' refers to the average number of years of education of a worker in that particular skill category.

TABLE 35

YEARS OF EDUCATION OF THE NEW LABOUR FORCE BY SKILL IN THE BASIC SOLUTION

	Period 1		Period 2		Period 3		Period 4	
	Average	Total	Average	Total	Average	Total	Average	Total
1. Farmer	1.69	10365	2.02	13113	2.00	16225	2.73	31034
2. Manual	5.46	4360	5.45	7165	5.38	9178	6.07	13903
3. Clerical and Sales	10.10	2799	7.20	2583	4.36	3559	3.95	4608
4. Administrators and Managers	10.93	77	11.02	628	15.00	504	12.44	759
5. Professionals and Technicians	10.77	1012	3.90	937	14.52	1161	14.71	1574
6. Total For All Skill	2.54	18612	2.89	24426	2.85	30627	3.46	51878

Notes : (1) Total figures are in 000 man years of education.

(2) 'Average' refers to the average number of years of education of a worker in that particular skill category.

TABLE 36

BASIC SOLUTION MARGINAL AND AVERAGE EDUCATIONAL INPUT PER PERIOD BY SKILL
(NUMBER OF MAN YEARS OF EDUCATION PER TK. 1 MILLION WORTH OF OUTPUT)

	Period 1		Period 2		Period 3		Period 4	
	Marginal	Average	Marginal	Average	Marginal	Average	Marginal	Average
1. Farmer	200.00	65.33	182.35	94.10	183.94	114.55	257.77	148.89
2. Manual	66.69	58.54	89.61	66.17	97.22	73.24	109.18	81.86
3. Clerical and Sales	40.86	40.93	26.50	37.38	33.68	36.54	32.71	35.62
4. Administrators and Managers	-0.40	3.79	7.98	4.82	4.96	4.85	8.10	5.05
5. Professionals and Technicians	16.43	11.92	10.68	11.61	11.40	11.57	11.54	11.56
6. Total For All Skill	323.58	180.51	317.12	214.08	331.20	240.75	419.30	282.98

TABLE 37

BASIC SOLUTION SHADOW PRICES

	Period 1	Period 2	Period 3	Period 4
1. Student Flow Constraints				
(i) Primary Graduate	-0.29	0.31	0.31	0.20
(ii) Primary Dropout	-0.21	0.22	0.23	0.21
(iii) Secondary Graduate	-0.45	0.48	1.10	0.62
(iv) Secondary Dropout	-0.34	0.36	0.38	0.33
(v) Higher Secondary Graduate	-3.86	0.74	0.67	0.62
(vi) Higher Secondary Dropout	-0.45	0.48	0.50	0.46
(vii) Primary Teaching Graduate	-	0.65	0.67	*
(viii) Primary Teaching Dropout	-	0.48	0.50	0.46
(ix) Secondary Teaching Graduate	*	*	*	*
(x) Secondary Teaching Dropout	-	0.68	0.67	0.62
(xi) University Graduate	-3.86	3.97	0.96	0.88
(xii) University Dropout	-3.86	0.84	0.67	0.62
2. Population Constraint	-0.10	-0.10	-0.10	*
3. Teacher Stock Constraints				
(i) Primary	3.23	0	0.67	0
(ii) Secondary	0	0	0	0
(iii) Higher Secondary	0	3.96	0	*
(iv) Primary Teaching	3.86	0	0	0
(v) Secondary Teaching	0	0	0	*
(vi) University	0	3.05	0.10	0.88
4. Building Stock Constraints				
(i) Primary-Secondary	0	-1.00	-0.62	0.09
(ii) Higher Secondary-Primary Teaching	0	1.69	0.01	-0.64
(iii) University-Secondary Teaching	0	1.21	0.03	-0.64
5. Equipment Stock Constraint				
(i) Primary-Secondary	2.48	-0.44	-0.45	-0.69
(ii) Higher Secondary-Primary Teaching	2.48	-0.44	-0.45	-0.69
(iii) University-Secondary Teaching	0	-0.37	-0.40	-0.67

6. Commodity Balance Constraints
   (i) Agriculture
   (ii) Manufacturing A
   (iii) Manufacturing B
   (iv) Construction
   (v) Electricity and Gas
   (vi) Transport
   (vii) Trade
   (viii) Services

7. Capacity Constraints
   (i) Agriculture
   (ii) Manufacturing A
   (iii) Manufacturing B
   (iv) Construction
   (v) Electricity and Gas
   (vi) Transport
   (vii) Trade
   (viii) Services

8. Skill Constraints
   (i) Farmer
   (ii) Manual
   (iii) Clerical and Sales
   (iv) Administrators and Managers
   (v) Professionals and Technicians

9. Foreign Exchange

10. Capital

11. Foreign Funds

12. Quality Constraint
   (i) Administrators and Managers
   (ii) Professionals and Technicians

TABLE 37 (Cont'd)--

Period 1	Period 2	Period 3	Period 4
1.29	0.25	0.22	0.15
0.77	0.69	0.50	0.34
0.74	1.08	0.74	0.57
1.05	0.79	0.61	0.30
-0.04	2.05	1.28	1.17
-0.17	0.72	0.45	0.40
-0.32	0.40	0.23	0.22
-0.13	1.15	0.57	0.35
-	0.10	0.06	0.04
-	0.18	0.11	0.08
-	0.38	0.24	0.17
-	0.05	0.03	0.02
-	1.71	1.02	0.75
-	0.67	0.36	0.28
-	0.44	0.20	0.18
-	1.02	0.44	0.42
0	.001	0.12	1.00
0	0	0.26	1.34
0	.002	0.34	2.81
2.55	0.29	0.52	4.23
2.72	0.58	0.41	3.36
1.94	1.39	0.97	0.72
1.48	0.29	0	0
3.42	1.68	0.97	0.72
-2.69	-0.06	0	0
-2.37	-0.11	0	0

TABLE 37

	Period 1
13. Additional Enrolment Constraints	
(i) Secondary	
(ii) Higher Secondary	
(iii) Primary Teaching	
(iv) Secondary Teaching	
(v) University	
14. Uneducated Workers	
15. Investment Growth Constraint	0
16. Export Growth Constraints	
(i) Agriculture	
Foreign	0.31
Regional	0.31
(ii) Manufacturing A	
Foreign	0.98
Regional	0.98
(iii) Manufacturing B	
Foreign	1.05
Regional	1.05
17. Terminal Constraints	
Economy	
(i) Agriculture	
(ii) Manufacturing A	
(iii) Manufacturing B	
(iv) Construction	
(v) Electricity and Gas	
(vi) Transport	
(vii) Trade	
(viii) Services	

(Cont'd)--

Period 2	Period 3	Period 4
	-0.21	-0.23
	-1.41	-1.97
	-1.10	-2.22
	-2.96	-3.35
	-4.64	-5.01
0.21	0.22	0.21
0.08	0.33	-0.30
1.08	0.69	0.59
1.08	0.69	0.59
0.61	0.39	0.37
0.61	0.39	0.37
0.18	0.14	0.11
0.18	0.14	0.11
		-0.01
		-0.03
		-0.05
		-0.01
		-0.22
		-0.06
		-0.02
		-0.02

TABLE 37 (Cont'd)---

	Period 1	Period 2	Period 3	Period 4
Education				
(i) Primary-Secondary				
Equipment				-0.31
Building				0
(ii) Higher Secondary-Primary Teaching				
Equipment				-0.31
Building				*
(iii) University-Secondary Teaching				
Equipment				-0.31
Building				*

Notes : (1) * Indicates that the constraint binding but shadow price is zero implying alternative optima exists.

(2) - Indicates that these constraints were incorporated as 'bounds' and hence no shadow price was obtained.

TABLE 38

MACRO-ECONOMIC RESULTS TO ALTERNATIVE ENROLMENT CONSTRAINTS

	Period 1	Period 2	Period 3	Period 4	Annual Compound Rate of Growth Over the Entire Period
1. Rate of Growth of Gross Regional Product (Over the Previous Period)					
S0	29.8	32.5	29.1	31.7	5.5
S1	29.8	32.6	29.3	31.6	5.5
S2	29.8	32.5	28.7	32.5	5.5
2. Rate of Growth of Consumption (Over the Previous Period)					
S0	28.0	31.0	29.4	32.4	5.4
S1	28.0	31.1	29.7	32.4	5.4
S2	28.0	31.0	27.5	33.5	5.3
3. Marginal Rate of Saving					
S0	23.0	23.0	19.1	18.0	
S1	23.0	23.0	19.0	18.0	
S2	23.0	23.0	23.0	18.3	
4. Incremental Capital/Income Ratio..					
A. Gross					
S0	3.1	3.1	3.6	3.3	
S1	3.1	3.1	3.6	3.3	
S2	3.1	3.1	3.7	3.2	
B. Net					
S0	2.8	2.7	3.1	2.8	
S1	2.8	2.7	3.1	2.8	
S2	2.8	2.7	3.2	2.8	

TABLE 38 (Cont'd)---

	Period 1	Period 2	Period 3	Period 4	Annual Compound Rate of Growth Over the Entire Period
5. Total Capital Inflow as % of Total Gross Investment					
S0	20.1	19.2	18.8	17.7	
S1	20.1	19.2	18.8	17.7	
S2	20.1	19.2	18.1	17.0	
6. Total Labour-Output Coefficient Per Period	Number of Workers per Tk. 1 Million Worth of Output)				
S0	120.2	110.0	107.3	106.1	
S1	121.3	109.7	106.4	111.3	
S2	120.1	109.6	106.9	106.1	
7. Average Years of Education of the New Labour Force					
S0	2.54	2.89	2.85	3.46	
S1	2.57	2.87	2.83	3.44	
S2	2.53	2.87	2.76	3.60	

Notes : S0 = Basic Solution, S1 = Solution without any enrolment constraint,

S2 = Solution with universal primary enrolment by Period 4.

MACRO-ECONOMIC

Period 1

1. Rate of Growth of Gross Regional Product (Over the Previous Period)

0	27.1
2000	29.8
3000	31.3

2. Rate of Growth of Consumption (Over the Previous Period)

0	25.4
2000	28.0
3000	29.3

3. Marginal Rate of Saving

0	23.0
2000	23.0
3000	23.0

4. Incremental Gross Capital/ Income Ratio

0	3.0
2000	2.8
3000	2.6

TABLE 39

RESULTS IN ALTERNATIVE FOREIGN FUNDS SOLUTIONS

Period 2	Period 3	Period 4	Annual Compound Rate of Growth over the Entire Period
29.4	25.9	27.9	5.0
32.5	29.1	31.7	5.5
32.0	33.7	31.1	5.7
28.4	24.8	21.6	4.8
31.0	29.4	32.4	5.4
30.6	35.4	31.8	5.7
23.0	23.0	21.7	
23.0	19.1	18.0	
23.0	15.8	17.3	
2.7	3.1	2.8	
2.7	3.1	2.8	
2.7	2.8	2.9	

TABLE 39 (Cont'd)---

	Period 1	Period 2	Period 3	Period 4	Annual Compound Rate of Growth Over the Entire Period
5. Total Capital Inflow as % of Total Gross Investment					
0	14.7	11.2	8.8	6.9	
2000	20.1	19.2	18.8	17.7	
3000	22.4	22.7	23.1	22.3	
6. Total Labour Output Coefficient Per Period	(Number of Workers Per Tk. 1 Million Worth of Output)				
0	123.6	113.9	113.2	106.2	
2000	120.2	110.0	107.3	106.1	
3000	118.7	108.8	108.2	104.4	
7. Average Years of Education of the New Labour Force					
0	2.69	2.72	2.81	1.84	
2000	2.54	2.89	2.85	3.46	
3000	2.53	2.84	3.60	3.28	
8. Value of the Objective Function Tk. Million					
0	79705.3				
1000	86780.1				
2000	93579.0				
3000	100057.1				

Note: The different solutions correspond to three different levels of foreign funds per period (incremental) expressed in terms of Tk. million.

SHADOW PRICES OF GRADUATES

	Primary Graduate	Primary Dropout
1. Foreign Fund =0 (Tk. Million)		
Period 1	*	*
Period 2	*	*
Period 3	*	*
Period 4	*	*
2. Foreign Fund = 1000 (Tk. Million)		
Period 1	-0.26	-0.19
Period 2	0.27	0.20
Period 3	0.28	0.21
Period 4	0.20	0.22
3. Foreign Fund = 1400 (Tk. Million)		
Period 1	-0.29	-0.21
Period 2	0.31	0.22
Period 3	0.31	0.23
Period 4	0.20	0.22
4. Foreign Fund = 2000 (Tk. Million)		
Period 1	-0.29	-0.21
Period 2	0.31	0.22
Period 3	0.31	0.23
Period 4	0.20	0.21

TABLE 40

AND DROPOUTS IN ALTERNATIVE FOREIGN FUNDS SOLUTIONS

Secondary		Higher Secondary	
Graduate	Dropout	Graduate	Dropout
*	*	*	*
*	*	*	*
0.33	*	*	*
*	*	*	*
-0.40	-0.30	-3.43	-0.40
0.43	0.32	0.66	0.43
0.99	0.34	0.60	0.45
0.62	0.33	0.62	0.46
-0.45	-0.34	-3.86	-0.45
0.48	0.36	0.73	0.48
1.10	0.38	0.67	0.50
0.62	0.33	0.62	*0.46
-0.45	-0.34	-3.86	-0.45
0.48	0.36	0.74	0.48
1.10	0.38	0.67	0.50
0.62	0.33	0.62	0.46

SHADOW PRICES OF GRADUATES AND

	Primary Teaching	
	Graduate	Dropout
1. Foreign Fund = 0 (Tk. Million)		
Period 1	*	*
Period 2	*	*
Period 3	*	*
Period 4	*	*
2. Foreign Fund = 1000 (Tk. Million)		
Period 1	-	-
Period 2	0.58	0.43
Period 3	0.60	0.45
Period 4	*	0.46
3. Foreign Fund = 1400 (Tk. Million)		
Period 1	-	-
Period 2	0.65	0.48
Period 3	0.67	0.50
Period 4	*	0.46
4. Foreign Fund = 2000 (Tk. Million)		
Period 1	-	-
Period 2	0.65	0.48
Period 3	0.67	0.50
Period 4	*	0.46

T/ 40 (Cont'd)---

DROPOUTS IN ALTERNATIVE FOREIGN FUNDS SOLUTIONS

Secondary Teaching		University	
Graduate	Dropout	Graduate	Dropout
*	*	*	*
*	*	*	*
*	*	*	*
*	*	*	*
*	-	-3.42	-3.43
*	0.60	3.53	0.75
*	0.60	0.85	0.60
*	0.62	0.88	0.62
*	-	-3.86	-3.86
*	0.68	3.97	0.84
*	0.67	0.96	0.67
*	0.62	0.88	0.62
*	-	-3.86	-3.86
*	0.68	3.97	0.84
*	0.67	0.96	0.67
*	0.62	0.88	0.62

TABLE 40 (Cont'd)----

	Primary		Secondary		Higher Secondary	
	Graduate	Dropout	Graduate	Dropout	Graduate	Dropout
5. Foreign Fund = 2600 (Tk. Million)						
Period 1	-0.32	-0.24	-0.50	-0.38	-4.14	-0.50
Period 2	0.33	0.25	0.53	0.40	0.75	0.53
Period 3	0.30	0.24	1.10	0.36	0.71	0.50
Period 4	0.21	0.22	0.63	0.33	0.63	0.47
6. Foreign Fund = 3000 (Tk. Million)						
Period 1	-3.96	-2.86	-6.14	-4.62	-43.75	-6.14
Period 2	3.05	2.98	6.39	4.81	10.73	6.39
Period 3	0.32	0.24	3.72	0.37	0.70	0.52
Period 4	0.24	0.25	0.72	0.38	0.72	0.54

Notes : (1) - indicates that the corresponding constraint is included as bound so that no shadow price is obtained.

(2) * indicates that the constraint is binding but the shadow price is zero, implying that alternative optima exists.

TABLE 40 (Cont'd)----

	Primary Teaching		Secondary Teaching		University	
	Graduate	Dropout	Graduate	Dropout	Graduate	Dropout
5. Foreign Fund = 2600 (Tk. Million)						
Period 1	--	--	*	--	-4.15	-4.15
Period 2	0.69	0.53	*	0.75	-4.26	0.86
Period 3	0.71	0.50	*	0.71	1.01	0.71
Period 4	*	0.47	*	0.63	0.90	0.63
6. Foreign Fund = 3000 (Tk. Million)						
Period 1	--	--	*	--	-43.75	-43.75
Period 2	9.13	6.39	*	9.01	44.88	12.18
Period 3	0.70	0.52	*	0.70	0.99	0.70
Period 4	*	0.54	*	0.72	1.03	0.72

Notes : (1) - indicates that the corresponding constraint is included as bound so that no shadow price is obtained.

(2) * indicates that the constraint is binding but the shadow price is zero, implying that alternative optima exists.

TABLE 41

EDUCATIONAL DISTRIBUTION OF THE NEW LABOUR FORCE BY SKILL IN ALTERNATIVE FOREIGN FUNDS SOLUTIONS

(in 000)

	Period 1				Period 2			
	0	1000	2000	3000	0	1000	2000	3000
1. Farmers								
(i) Primary Graduate								
(ii) Primary Dropout	3455.1	3455.1	3455.1	3455.1	4455.5	4466.5	4371.0	4291.9
(iii) Uneducated	2694.0	2694.0	2694.0	2694.0	1466.6	1890.9	2121.7	2083.8
2. Manual								
(i) Primary Graduate	417.8	454.7	448.5	442.2	932.7	1035.6	1030.5	1029.4
(ii) Secondary Dropout	208.6	208.6	208.6	208.6	129.4	121.4	122.8	124.1
(iii) Uneducated	142.0	142.0	142.0	142.0	1018.7	382.1	161.7	210.1
3. Clerical and Sales								
(i) Primary Dropout						124.0	198.3	260.1
(ii) Secondary Graduate	290.0	282.4	276.6	270.5	162.7	133.9	138.7	143.7
(iii) Higher Secondary Graduate								
(iv) Higher Secondary Dropout						19.2	18.4	18.0
(v) Primary Teaching Dropout	0.3	0.3	0.3	0.3	1.3	3.9	3.8	3.8

TABLE 41 (Cont'd)------

EDUCATIONAL DISTRIBUTION OF THE NEW LABOUR FORCE BY SKILL IN ALTERNATIVE FOREIGN FUNDS SOLUTIONS (in 000)

	Period 3				Period 4		
	0	1000	2000	3000	0	1000	2000	3000
1. Farmers								
(i) Primary Graduate						60.8	489.8	919.4
(ii) Primary Dropout	4155.4	3567.3	5408.3	8367.8	4826.1	8552.5	9365.1	8341.2
(iii) Uneducated	2994.7	3698.9	2684.4	927.3	4930.5	2290.4	1521.7	2225.6
2. Manual								
(i) Primary Graduate	1365.8	892.3	1417.7	2368.1	1042.6	2261.6	2205.2	1434.4
(ii) Secondary Dropout	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0
(iii) Uneducated		272.7	203.3					
3. Clerical and Sales								
(i) Primary Dropout	1760.4	752.2	682.5	926.7		588.0	1031.6	905.2
(ii) Secondary Graduate								
(iii) Higher Secondary Graduate		85.3	35.5	60.8		62.5	35.5	29.0
(iv) Higher Secondary Dropout	98.7	98.7	98.7	98.7	98.8	98.8	98.8	98.8
(v) Primary Teaching Dropout								

	0
4. Administrators and Managers	
(i) Secondary Graduate	2.0
(ii) Higher Secondary Graduate	
(iii) Higher Secondary Dropout	
(iv) Secondary Dropout	
(v) University Graduate	0.2
5. Professionals and Technical	
(i) Primary Dropout	
(ii) Secondary Graduate	188.3
(iii) Higher Secondary	
(iv) Higher Secondary Dropout	27.5
(v) University Graduate	24.0
(vi) University Dropout	

TABLE 41 (Cont'd)---

Period 1			Period 2			
1000	2000	3000	0	1000	2000	3000
4.2	6.6	8.9				
			7.2	5.5	5.7	5.7
			64.5	49.8	50.9	51.3
0.5	0.7	1.0				
				211.9	216.1	216.2
53.0	56.8	60.7				
				23.3	23.8	23.8
27.5	27.5	27.5				
8.9	9.4	9.8				
			0.2	0.2	0.2	0.2

TABLE

	Period 0	Period 1000
4. Administrators and Managers		
(i) Secondary Graduate		
(ii) Higher Secondary Graduate	27.7	
(iii) Higher Secondary Dropout		
(iv) Secondary Teaching Dropout	1.0	
(v) University Graduate		41.7
5. Professionals and Technical		
(i) Primary Dropout		
(ii) Secondary Graduate		
(iii) Higher Secondary Graduate	48.8	
(iv) Higher Secondary Dropout		
(v) University Graduate	61.4	49.4
(vi) University Dropout	15.7	23.4

41 (Cont'd)----

3			Period 4		
2000	3000	0	1000	2000	3000
	17.8	76.4	26.5	53.5	60.0
33.6	24.6	1.0 33.7	13.4	7.8	4.5
57.8	66.6	27.7	78.1	83.9	87.0
21.9	23.9	15.7		23.4	23.4

TABLE 42

MACRO-ECONOMIC RESULTS IN ALTERNATIVE DROPOUT RATE SOLUTIONS

	Period 1	Period 2	Period 3	Period 4	Annual Compound Rate of Growth Over the Entire Period
1. Rate of Growth of Gross Regional Product (Over the Previous Period)					
D1	29.8	32.5	29.1	31.7	5.5
D2	29.7	33.5	30.5	30.0	5.5
2. Rate of Growth of Consumption (Over the Previous Period)					
D1	28.0	31.0	29.4	32.4	5.4
D2	28.0	31.5	31.2	30.3	5.4
3. Marginal Rate of Saving					
D1	23.0	23.0	19.1	18.0	
D2	23.0	23.0	18.4	19.0	
4. Incremental Net Capital/Income Ratio					
D1	2.8	2.7	3.1	2.8	
D2	2.8	2.6	3.0	2.9	
5. Total Capital Inflow as % of Total Gross Investment					
D1	20.1	19.2	18.8	17.7	
D2	20.1	18.8	18.4	17.3	

TABLE 42 (Cont'd)----

	Period 1	Period 2	Period 3	Period 4	Annual Compound Rate of Growth Over the Entire Period
6. Total Labour Output Coefficient Per Period	(Number of Workers Per Tk. 1 Million Worth of Output)				
D1	120.2	110.0	107.3	106.1	
D2	120.2	110.4	108.2	100.7	
7. Average Years of Education of the New Labour Force					
D1	2.54	2.89	2.85	3.46	
D2	2.56	2.93	5.08	4.08	
8. Value of the Objective Function (Tk. Million)					
D1	93579.0				
D2	94437.0				

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